ROADS And STREETS

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Waiting for the Plow to Come Again. Drifting shut was the usual thing due to the high wind.

SNOW REMOVAL IN SOUTHEASTERN WISCONSIN

Organization—Equipment Methods—Costs—Results

By W. D. TOMLINSON

Senior Assistant Highway Engineer, State Highway Commission of Wisconsin

THE law makes the State Highway Commission of Wisconsin responsible for the care of the state trunk system of approximately 10,200 miles, but further specifies that the state may enter into agreements with the counties to furnish men, machinery and materials for the maintenance of the state mileage within their borders. The State takes advantage of this permission. Counties are reimbursed monthly for their expenditures. All machinery is paid for on a rental basis, the rate being adjusted each year. The rate paid for trucks over two tons capacity and for tractors is higher for snow removal than for any other type of work.

Wisconsin is divided into 9 divisions, each division containing from 5 to 10 counties. Division 2 comprises the southeastern part of the state, and includes Milwaukee and smaller places to the number of 81, and has a population of about one million. In addition, the southern edge of the territory is less than 40 miles from Chicago. It will readily be realized that open roads at all times are a necessity.

Snow Fence

The first line of defense against snow blockades is the snow fence. This is set 75 to 100 feet from the road, and on the side from which most of the drifting comes. About 90 per cent of the fence is of the 4-ft. wood picket type, hung on 6-ft. iron posts. The balance is of the metal slat type. It is the opinion of the writer that 8-ft. posts might well be used. Such posts would permit the fence to be raised when the drifts reach the top as originally set. Posts are driven before the frost enters the ground, but the fence is not usually hung until the ground is frozen. This minimizes the damage to farm land and facilitates moving the heavy rolls of fence from the road to point of use.

Wisconsin law permits placing snow fence on private property without payment to the owner unless there is actual damage to crops or fences. In general the owners appreciate an open road and are quite willing to permit

A Well Plowed Road
S. T. 144, *Sheboygan County, January,* 1936

the fence. There are a few exceptions. In these cases, if the objection is valid, such as to fence through an orchard, or if the location is unimportant, the fence is omitted. If the erection is necessary the fence is put up, and if molested, the offender is dealt with according to law. While not in use the fence is piled at the side of the road, or hauled to some central storage place. Piling at the side of the road is more economical, but unfortunately the fence does very well as a pen for pigs, chickens, or babies, and if left out is apt to be borrowed freely. Most of it is eventually recovered in the fall, but considerable time is lost in locating and collecting it.

In our opinion it is possible to have too much fence as well as too little. When this condition is reached, the cost of handling the fence exceeds the cost of removing the extra snow. Since the plow must go over the road,

A Road Opened by Caterpillar RD 8 with La Plante-Choate Plow, S. T. 144, Barton Hill, Washington County, February 27, 1936.

it makes but little difference whether it runs light or works to capacity so long as it can progress in high gear. It is impossible to give a definite economic limit for the amount of snow fence, due to the variation of topography and weather. Each road and each mile is a study in itself, but we believe the upper economic limit to be about 1,000 ft. for the average mile in this territory.

Small Trucks

When actual snow removal starts, trucks of about 1½ tons capacity are sent out first. There is one of these available for about each 30 miles of state trunks. As far as possible they are operated by the regular man who runs them through the summer, and on the same routes. There is a decided advantage in having drivers who are thoroughly familiar with the ground over which they are operating. A helper is sent with each driver, and most of the helpers are capable of taking a trick at the wheel. As soon as snow has fallen to a depth such that the plows can get a bite, the trucks start out and keep working night and day until the work is done or until the depth is so great that the light units can no longer operate.

Commonly these light trucks are kept at or near the homes of the drivers. Most of these men are of good intelligence and have instructions to go out when they think it is necessary. This is done because it is not always possible to determine immediately from headquarters just what conditions may be at distant points. Before starting out the men notify the central shop of conditions and that they are going. The superintendent, if he has not already done so, proceeds to find out the area and intensity of the storm and make sure that other drivers are out if necessary.

Generally the light trucks can clean the snow from the pavement, and if the fall is not too heavy, push it off the shoulders and into the ditches. The importance of clearing the entire pavement and shoulders at once cannot be too much emphasized. The snow moves more easily when fresh, thawing takes place in the ditch off the road, and if a wide area is cleared, there is room for the next fall. Light trucks, in the main, are equipped with one-way plows, many different makes of which are in use. If there is no wind these plows will handle almost any snow which usually falls, although they are not recommended for depths above 6 or 8 inches, and then only if the snow is light.

Large Trucks

When the smaller units can no longer progress, the larger ones are dispatched. Among the larger trucks in use are almost all of the nationally known makes, for each county is free to purchase the type and make which it considers the most efficient. Because the trucks are used during the summer season also, year round economy must be considered as well as fitness for winter work. Sizes normally range from 2½ to 6 tons. During the extreme conditions of last winter, several of 7½ to 10 tons capacity made their appearance. There are about 175 trucks over 2½ tons owned by the counties of this division. This is an extremely large amount of equipment when only the 1,227 miles of state trunks are considered. The counties however, remove snow from nearly 1,900 miles of county trunks and an estimated 3,000 miles of town roads. Except for the work done by town owned equipment, not considered in this article,

How Hand Workers Assisted the Machines U. S. 45 Near North Cape, Racine County, February 25, 1936

town roads get no attention until state and county roads are in good shape.

Due to the fact that the county headquarters are usually near the center of the county, from 4 to 10 larger units are kept there. The others are kept in groups of one to 5 or 6 at strategic outlying points, where enclosed and usually heated storage space is available, either in county-owned or rented buildings. All drivers are recruited from among regular employees. Trucks are, of course, assigned to positions where they can operate best, but other things being equal are sent to the station nearest the residence of the regular driver.

Most counties consider the front and rear drive truck superior to those driving from the rear only, for snow work. Trucks driving on all four wheels can be held in position better when bucking a side bank, and have superior traction. There are some good men in the work who differ with this view, but they are in the minority.

Tractors

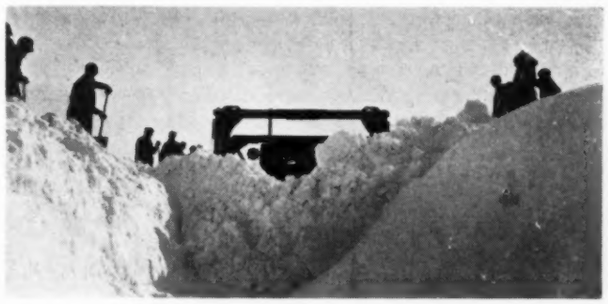
Our main reliance in snow removal must be on the comparatively fast moving truck. In this age, everybody wants his road opened first. Nevertheless, the tractor has its place in widening banks thrown up by the trucks, and in heavy drifts. Possibly the large, powerful truck could, by reason of the momentum due to its speed, ram through any but the most difficult going that a tractor is called upon to handle. However, the breakage in ramming and bucking is terrific and for this reason the tractor is preferable when a truck can no longer get through without backing and hitting. Unless the snow is wet, tractors can get through drifts 8 or possibly 10 feet deep. If there is more snow than this, the plow must be raised to permit the tractor to travel over part of the snow on the first cut. On bituminous surfaces raising the plow a bit is good practice at any time in order to prevent damage to the surface. If this is done, a light truck follows the tractor to clean up.

Rotary Plows

Rotaries are little used in this part of the state, because the snow of any ordinary winter can be more cheaply and quickly handled by displacement plows. But two are in use. One is of a make now obsolete and is about as efficient as two small boys throwing snow balls. The other is a "Snow King" mounted on the back of a Super Truck. This truck moves forward or back with equal facility, thus making it possible to mount the plow and power unit in the cargo space. The rotary is driven by a 100 h. p. Waukesha motor, independent of the truck motor. The power available for the rotary will be doubled for the coming season. The machine was assembled by Mr. W. J. Ubbink of Ozaukee county and gave good service last winter. While rotaries are the last resort, when conditions justify their use, they are economical. The unit described above, at work on U. S. 141 made 2½ miles in 10 hours at a cost of $22 per mile. A 10-ton 200-h.p. front and rear drive truck, with "V" plow, started from a point 8 miles away and worked toward the rotary. The truck by backing and ramming made 2½ miles in 48 hours at a cost of $86.40 per mile, a decided difference in favor of the rotary. Complete rotary billed at $4.50 per hour, truck and plow at $3.50 per hour, with two men at 50 cents per hour on each rig.

Graders

Patrol graders, except under special conditions, are not often used in snow removal, for they are too slow. In the case of a moderate fall of snow which is heavy



In Deep with the 97 H.P. Caterpillar and La Plante-Choate Plow, S. T. 57, North of 84, Ozankee County, February 21, 1936.

and wet and which packs under traffic, they are the only machine which will clean down to the surface of the pavement. At one dollar per hour for the machine plus 50 cents for the operator, the cost of this work runs 40 to 50 cents per mile of useful travel. If the pavement is thoroughly cleaned, less subsequent sanding is necessary. Thus in addition to the increased comfort and safety of travel, there is a saving in ice control and removal.

Procedure

Each piece of equipment has its prescribed route to cover, roads of primary importance being taken care of first. While it is desirable to prepare a schedule for each unit, and possibly to follow the schedule under ordinary conditions, the work must be prosecuted as conditions warrant if the storms become severe. Breakdowns as well as varying snow and traffic make rerouting of equipment necessary many times. In bad storms all

A Rear View of Rotary Plow Operation. Super Truck Backing Snow King Through a Drift. County Road, Ozankee County, February, 1936

¾ Yard Northwest Shovel with Standard Dipper on S. T. 15, Waukesha County, February 25, 1936
This machine was equipped with a 3-yard dipper a few days later

plows may have to be concentrated on a few important roads, while roads of lesser importance are left untouched temporarily. Machines sometimes operate continuously for a month or six weeks, stopping only for fuel and repairs. When such sieges are encountered, many operators, when off duty, sleep at their stations where beds are provided, and also cooking facilities in some instances. Crews are changed on the road, the relief crew driving to the location reported by the retiring one, and carrying fuel and oil for the next shift. Shifts are planned for 8 to 12 hours.

Report Service Important to Public

Two to four times each shift, each crew reports its progress and location to county headquarters and receives instructions. County headquarters report one to three times daily to the division office, and the division office as often to the main office of the State Highway Commission. Such a system of reporting is of extreme importance in routing the units and in getting accurate and up to the minute information to the public, press and radio. The hundreds of inquiries received daily as soon as snow falls, show that this service is needed.

Power Shovels

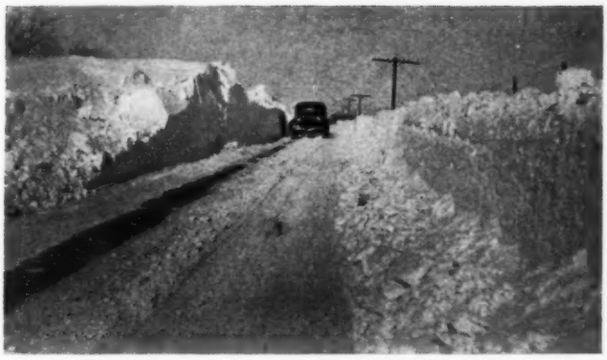
For widening drifts which withstood everything else during the severe period in the early part of this year, power shovels were called upon. These were equipped with special light dippers of from three to five times normal capacity. The special dippers were made up hurriedly, from rough sketches, by machine shops or county forces and cost about $225 each. They worked well, but 10,000 yards of snow in a mile is a lot to move, even in 5-yard bites, and one mile a day is not very fast progress when there is a hundred miles to go. Only the bigger drifts were touched with the shovels, of which 25 were working at one time. Shovels were rented at about $3.50 per hour, exclusive of operators, who were paid $0.80 to $1.25 per hour, depending upon location. Some days the shovels would move a mile or more, and other days only a quarter of a mile, according to the amount of drifting. Shoveling snow looked like easy money to some shovel owners, but it was soon found that the large amount of traveling wore the tracks badly. Rotaries would have been cheaper, but they were not to be had.

Not Open to Traffic: Widening Still to Be Done, U. S. 41, Racine County, February 18, 1936.

Widening Done with a Kochring ¾ Yard Shovel S. T. 100, Milwaukee County, February 16, 1936

Conditions—1935-1936

The table shows the snow fall during December to March inclusive last winter. Sixty inches of snow in four ordinary winter months should cause little trouble. Last winter from mid-December to March the temperature did not get above freezing, and fell as low as 35 degrees below zero. Winds blew incessantly, swinging from every point of the compass, except straight sonth, and with velocities up to 45 miles per hour. All of the snow which fell in December was still on the ground at the beginning of March. Roads were blocked in some instances for days, by drifts which defied even the 100-h.p. tractor and 10-ton truck. During much of February every unit was accompanied by 5 to 30 hand shovelers. Expensive? Yes, but when the biggest machine available will not go through, what else can be done?



Work of the Snow King Rotary
U. S. 141, *Ozankee County*

Costs

Month	Snow Fall in Ins.	Cost of Snow Removal Labor	Cost of Snow Removal Machinery	Per Mile* Cost of Snow Removal Labor	Per Mile* Cost of Snow Removal Machinery	Cost Per Mile Per Inch of Snow Labor	Cost Per Mile Per Inch of Snow Machinery
Dec.	9.70	$ 4,821.55	$ 7,057.30	$ 3.91	$ 5.73	$0.40	$0.59
Jan.	20.98	27,636.70	48,229.81	22.43	39.14	1.07	1.87
Feb.	22.99	96,359.58	99,203.26	78.19	80.50	3.40	3.50
Mar.	6.35	13,495.82	27,454.60	10.95	22.28	1.72	3.50

*Average for 1,227 miles.

A glance at the table brings out some interesting comparisons. During December, with about 10 ins. of snow, it cost $0.99 to move an inch of snow off a mile of road. In January, with a maximum average of 31.68 ins. on the ground, the cost rose to $2.94 for the same quantity. In February, with 23 additional inches to be boosted over the top of the previous falls, the cost jumped to $6.90. There was little snow, and a considerable amount of thawing during March. With more room to put what did fall, the cost dropped to $5.22, which would have been greatly decreased, had it not been for the cleaning up of the old February snow; this work extended over into March.

Note the difference in the relative proportions of cost chargeable to labor and to machinery during December and January as compared to February. February was the month when most of the hand labor was used. In March the manual assistance to the plows was unnecessary, but the power shovels for widening came into play, running the machinery cost comparatively very high.

Esprit de Corps

Without the whole-hearted efforts of the boys on the road, we would have been helpless. Those who manned the plows at 20 to 35 below zero and drove through the night in the whirling, hissing smother; who stayed on the road by some sixth sense, when eyes were useless; and who came back for more day after day, did it for something besides their pay check. Our hats are off to them. We hope it snows next winter, but not quite so much at one time.

Snow Piled Up with a ¾ Yard P. & H. Crane S. T. 57, Ozankee County, February 27, 1936

American Road Builders' Assoc. Meets in New Orleans in January

The 1937 Convention and Exhibit of the American Road Builders' Association will be held in New Orleans, La., during the week of next January 11, according to announcement made by Charles M. Upham, engineer-director of the association. This will be the first time the A.R.B.A. has held its convention in the South.

The selection of New Orleans was made by the joint Convention and Exhibit Committee following a series of conferences called to consider invitations extended by a number of cities.

The 1937 program will be drafted with the Convention as the central feature of the national highway conclave, according to Mr. Upham. No effort will be made to hold a heavy-equipment road show, but booths will be available to manufacturers of equipment and producers of materials who desire to exhibit models and literature. The fact that no heavy equipment will be exhibited made it possible for the joint committee to consider the invitations of cities that have abundant hotel accommodations but that do not have facilities for displaying heavy machinery.

The 1937 convention program, as drafted by a special committee designated to determine subjects and speakers, gives assurance that the range of highway topics and the qualifications of speakers will set a new record at the New Orleans meeting.

Col. Willard T. Chevalier, president of the A.R.B.A., who during recent months has addressed meetings of road builders in all sections of the country and has discussed current highway problems with leaders of the industry and profession, said the 1937 convention program will cover many new subjects of vital interest to those who are building and maintaining the nation's highways and streets.

"The 1936 Convention and Road Show of the American Road Builders' Association, held in Cleveland, demonstrated that members of the highway industry and profession are in a highly receptive attitude toward all policies that will effect economies and stability in road building," said Colonel Chevalier. "The New Orleans convention must supply all of the information that road builders desire in connection with highway administration, financing, engineering, construction, and maintenance. Also, it is absolutely necessary that the convention serve as a clearing-house for the very latest information on highway safety and other allied subjects that are an integral part of highway transportation."

The highway program for the current fiscal year will involve the expenditure of more than a billion dollars. Congress has authorized Federal-aid through the fiscal year 1939, thus providing an orderly construction program for the next three years. One of the new items that will enter into the two-year program beginning next year is the authorization made by Congress for Federal-aid for secondary and farm-to-market roads. The coming A.R.B.A. convention program will include full discussion of policies proposed for the most effective application of these funds.

An European Snow Plow and Wing Design

Norway, with its heavy snows, has correspondingly heavy problems in keeping its highways open—especially in the steep and narrow mountain passes, where drifts pile high, sometimes separating communities for weeks. "Snowbreaking," as the Norwegians term their snow-removal operations, has, in recent years, been of vital importance in the economic and social life of the people.

Mr. Johnnie Colbjornsen, equipment dealer at Oslo, says, "It has laid immense work on our shoulders. Our methods of meeting the problem are studied by road experts from several European countries. Every winter they visit us. From their observations they learn to better meet their problems, and have even purchased snowbreaking equipment from Norway."

Norwegian Plow and a Specimen of Its Work

Working with Mr. Colbjornsen on this problem is an engineer who, after studying various type of plows, has designed a "V"-type front end plow similar to American designs. The accompanying picture shows one of these plowes mounted on an FWO truck imported from the United States. The wing was designed and built by the same people as the plow. It is of right angle shape, with a wide bottom blade and a 3-ft. side. Connected to the end of this wing is another, slightly tapered in design but of similar appearance. With this device, snow which falls to the right of the "V"-plow, is speedily picked up and thrown high and wide over the road, leaving a clean roadway and smooth, sheer banks, similar in appearance to those made by a rotary.

A.S.C.E. to Meet at Pittsburgh in October

Three Local Sections of the American Society of Civil Engineers are co-operating with the local committee and the Technical Divisions in arranging the program for the fall meeting of the Society, to be held at Pittsburgh, Pa., October 13-17, 1936. The Pittsburgh Section, in addition to acting as host to the visiting members, has arranged a discussion of flood control problems and is co-operating with the Structural Division in the presentation of a symposium on the structural applications of steel and light-weight alloys; also with the City Planning and Surveying and Mapping Divisions in preparing their programs.

The Cleveland Section, in conjunction with the Sanitary Engineering Division, is sponsoring a symposium on stream pollution, and the Central Ohio Section has joined with the Highway Division in preparing a technical session on modern highway design and construction.

In all, eight Technical Divisions are to be represented on the program. In addition to those already mentioned, the Waterways Division has scheduled two sessions, and the Power and the Engineering-Economics and Finance Divisions will hold two combined sessions. As a result, the fall meeting will depart from the customary four-day schedule and begin on Tuesday, reserving the morning and afternoon of the opening day for two general sessions.

Flood control has been selected as the subject of these general sessions. The floods recently experienced by Pittsburgh and many other cities of the eastern states, and the impetus given to flood control by congressional action a short time later, provide the background for a timely discussion that should attract the attention of the general public as well as of engineers. Wednesday and Thursday will provide two full days for the technical sessions.

Friday will be reserved for excursions to some of the Pittsburgh laboratories and industries. These excursions, as far as possible, will be correlated with the papers presented at the technical sessions. The program so far prepared is of unusual general and technical interest in keeping with the engineering importance of the Pittsburgh, Cleveland, and Central Ohio regions.

During the meeting, representatives of 28 Local Sections will attend a regional conference to discuss problems that have already been given attention at Hot Springs and Portland. A detailed abstract of the Hot Springs conference has been mailed to all Local Sections, and a similar review of the Portland proceedings will be made available some time in August, so that while the agenda remains the same, the full conference will be able to take up the discussion where it was left off at the other meetings. A regional conference of Student Chapters is also scheduled.

The committee of the Pittsburgh Section in charge of arrangements for the fall meeting consists of A. V. Karpov, chairman, and the following: U. N. Arthur, W. H. Buente, John N. Chester, Robert A. Cummings, Allen S. Davison, R. P. Forsberg, E. N. Hunting, H. D. Johnson, Jr., Richard Khuen, Jr., J. F. Laboon, M. G. Mansfield, L. C. McCandliss, L. W. McIntyre, E. K. Morse, John M. Rice, L. J. Riegler, and C. B. Stanton. George E. Barnes and George B. Gascoigne represent the Cleveland Section, and R. R. Litehiser and William E. Burroughs the Central Ohio Section.

Bridge No. 1—Outlet End

TWO SMALL CONCRETE BRIDGES

In Niagara County, New York

By RICHARD M. RUMSEY

Superintendent of Highways, Niagara County, Lockport, N. Y.

THE structures here described were built in July and August, 1935, by county forces. Both are simple slab bridges without extraordinary features affecting either design or cost.

The first, which for convenience will be designated "Bridge No. 1," has a 10 ft. 0 in. clear span and a length of 63 ft. 0 in. from out to out of parapet walls. Footings are 2 ft. 6 in. wide and 1 ft. 0 in. thick, with a 6 in. projecting key to hold the wall abutment. Walls are 5 ft. 6 in. high, 2 ft. 0 in. wide at the footing, and taper to an even 12 in. at the top. There is a small, V-shaped keyway in the top of each wall. Both footings and abutments are of plain concrete, 1:2½:5 mix.

The slab is 12½ in. thick, reinforced on the tension side with ¾ in. round longitudinal bars spaced 5 in. on centers with every third bar bent up, and with 1½ in. round transverse bars spaced 12 in. on centers. The mix is 1:2:3½.

Bridge No. 1—Inlet End
The high wing walls are provided because of an intersecting road at this point

The wall at the outlet end is 2 ft. 0 in. thick at base and 1 ft. 6 in. at top, and has a length of 21 ft. 6 in. It is on a 30 degree skew. There are no wing walls at this end of the structure, but at the inlet end there are two—one extending directly as a continuation of the abutment, and the other forming a 60 degree angle therewith. Each is 12 ft. long, with its top even with the top of the parapet wall, which is only 9 in. higher than the bridge slab. Railings are of 3-in. wrought iron pipe.

All exposed edges of concrete are chamfered, and all exposed surfaces are finished by rubbing with carborundum stone.

The cost of this bridge was as follows:

	Quantity	Cost
Earth excavation	307 cu. yds.	$ 584.46
Run of bank gravel (backfill)	22.5 cu. yds.	16.70
Pipe underdrain, 4-in. diameter	120 lin. ft.	7.47
Portland cement	158.25 bbls.	386.13
Stone for concrete	144.5 tons	180.57
Sand for concrete	78.5 tons	61.55
Misc. material, lumber, nails, wire, etc.		47.05
Bar reinforcement	3,984 lbs.	109.47
Pipe railing	31.5 lin. ft.	81.34
Truck hire		258.50
Mixer		66.46
Labor		1,126.03
Total cost		$2,925.73

Earth excavation includes $337.37 for labor and $247.09 for truck crane. The item labor includes all carpenter work, concrete finishers, placing underdrain, etc. There is 115.67 cu. yds. of concrete in this structure. This is at the rate of $46.44 per lin. ft. for the cost exclusive of engineering.

Bridge No. 2 has a clear span of 20 ft. 0 in. and a width of 33 ft. 0 in. between outside faces of parapet walls. Footings are 4 ft. 6 in. wide and 2 ft. 0 in. thick with 6 in. projecting key. Abutment walls are 6 ft. 10 in. high, 3 ft. 9 in. wide at base and 1 ft. 6 in. at top.

The slab is 1 ft. 8½ in. thick, reinforced on the tension side with ⅞ in. round longitudinal bars spaced 4 in. on centers, with every third bar bent up, and with ½ in. round transverse bars spaced 12 in. on centers. The slab is cast monolithic with the abutment at one end, and at the other rests on a tar paper joint for expansion. A camber of 1¼ in. was provided in the slab forms.

Parapet walls extend 2 ft. 2 in. above the slab to form the bridge rail, and are carried 12 ft. back from the abutment at each end. The surfaces are jointed to give a masonry effect, the joints being made ¾ in. strips nailed to the forms. The blocks so developed measure approximately 1 ft. by 3 ft.

Bridge No. 2

Architectural pilasters 4 ft. wide at the base, 3 ft. at the top, and projecting 4 in. beyond the face of the wall are located at each abutment end. A ¾ in. premoulded expansion joint is provided between the main parapet wall and each pilaster.

Concrete mixes and finish are the same as for Bridge No. 1.

The cost of Bridge No. 2 was as follows:

	Quantity	Cost
Earth excavation	350 cu. yds.	$ 511.35
Backfill run of bank gravel	239.5 cu. yds.	177.81
Pipe underdrain, 4-in. d'ameter	50 lin.ft.	7.41
Portland cement	219 bbls.	534.36
Stone for concrete	205.75 tons	257.19
Sand for concrete	117.50 tons	92.32
Mis. materials, lumber, etc.		137.84
Truck hire		481.87
Bar reinforcement	6,285 lbs.	161.49
Mixer		66.19
Labor		985.81
Cofferdams, pumping and bailing		101.00
Total cost		$3,514.64

Earth excavation includes $308.33 for labor and $203.02 for truck crane. This structure contains 164 cu. yds. of concrete.

The road surface on each bridge is a 3-in. penetration course with 1 in. of pre-mixed bituminous macadam.

The working day on construction of these bridges was 8 hours. The common labor rate was 50c. The carpenter was paid 75c and acted as foreman for his gang: in other words he was a working foreman. One or two good laborers did the concrete finishing at no increase in pay. The county's general foreman or the superintendent visited the job at least once each day during construction. The work was laid out by the engineer in charge.

Excavation was by truck crane, for which a charge of $4.00 per hour was made. The concrete mixer—a 7S—was charged at 50c per hour. The charge for trucks was $2.50 per hour, which rate included the operator, gasoline, oil and incidentals.

Engineering costs include the design, layout in the field and inspection. Due to the fact that the engineer was in charge of the entire road, it was difficult to get the supervision costs for these bridges accurately.

Among the factors which have been observed as affecting costs on this class of work are length of haul from quarry or gravel pit, availability of equipment (especially the concrete mixer) when needed, and the availability of the carpenter foreman when needed.

Novel Lubrication Installation Simplifies Maintenance of Excavator

A well-planned lubrication installation was employed on the large Bucyrus-Monighan dragline working on a recently completed canal-widening project at Blue Island, Ill. The contractors were Morrison-Knudsen, Inc., Boise, Idaho.

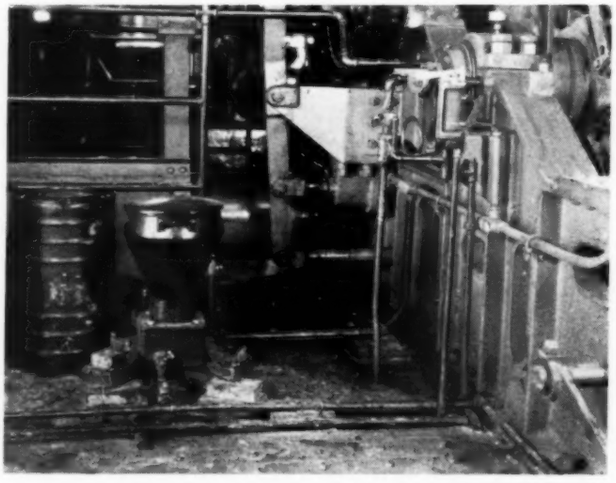
In the cab was mounted an Alemite air operated grease power gun. With a lubricant delivery of from 12 to 18 ounces per minute at air pressures of from 150 to 200 lbs., this gun utilized only a portion of the machine's air supply, the rest being kept in check by an air regulator.

Four outlets were used in this installation in order to simplify the lubrication of the many fittings on the machine, there being 150 fittings on the outside rollers alone. One of the inside outlets, for example, consisted of a 20-ft. hose line, complete with a control valve and whip-end hose. The lubricating end of the whip-end hose was equipped with a pull-on buttonhead coupling to permit a leak-proof seal during lubrication. The other end had a coupling and check valve.

The lubricant being maintained in the line under pressure at all times, the operator had merely to make a quick connection of the whip-end hose between the fitting to be lubricated and the fitting in the line shut-off valve, then open the valve. Thus the simple operation of the control valve gave finger-tip control over the pressure for instantly flushing all the worn grease out of the bearing and shooting fresh lubricant in.

To disconnect the hose and use it on another outlet in an installation of this sort, the line shut-off valve is closed, the pressure in the hose released, and another fitting or two given shots of the remaining lubricant. The hose can then be removed easily.

The other outlets on the installation were similarly equipped, the outside fittings being reached via a pipe which extended through the cabin wall.



Lubricating Gun Installed in Dragline Cab

The
Highland Park,
Michigan

The Permanent Railroad Bridge, with Temporary Structure Visible Below

GRADE SEPARATION

By MURRAY D. VAN WAGONER
State Highway Commissioner of Michigan

IN the heart of the world's automobile capital the Michigan state highway department today is constructing one of the most intricate and interesting structures on its $6,700,000 grade separation program.

The project is adjacent to the old Highland Park plant of the Ford Motor Company in the city of Highland Park, Mich. The structure is located on what people of the Michigan metropolitan area call Woodward Avenue, which is also US-10, the most heavily-traveled highway in the state. This highway will be carried under two tracks of the Detroit Terminal Railroad.

The old grade crossing was not particularly dangerous from a viewpoint of railroad traffic. However, the passage of trains at the crossing resulted in so many traffic jams that the crossing has for years led to many serious automobile accidents.

When the project is completed, the new structure will provide a 90-ft. clear roadway with a 1-ft. curb clearance on each side and a 14-ft. minimum underclearance. A 10-ft. sidewalk will be provided through each of the box-type abutments.

The railroad superstructure is of half-through steel plate girder design. The main girders are made of silicon steel to permit the use of high-unit stresses in the design so as to reduce the necessary depth of the girders with a resulting savings in roadway excavation and track raise. Railroad tracks are being raised approximately 10½ ft. at Woodward Avenue with run-offs on each side. The highway is being depressed about 8½ ft. The foundation of the structure is on hard blue clay and will require about 1,400 cu. yd. of concrete, 75 tons of reinforcing steel and 345 tons of structural steel.

Pavement Construction at the Underpass—Temporary Trestle Shown in Front of Permanent Bridge

Approaches to the grade separation will be about 650 ft. long with a 90-ft. roadway between curbs. Paving construction embraces two parallel lanes of heavy concrete base 36 ft. wide with an 18-ft. concrete encasement for the double track street railway in the center. A 6½-ft. brick parking area will be placed on each side of the roadway and the remainder of the street will be surfaced with 3½-in. sheet asphalt. Approximately 18,000 cu. yd. of excavation are required for the approaches.

Sidewalks on the approaches will be 15 ft. wide. Extensive alterations had to be made in existing sewers, water mains, and other public utilities. After completion of the structure and approaches, the cut banks and finished slopes will be given special landscaping treatment so that the appearance of the finished work will conform favorably with the surrounding area.

The most unusual feature of this project is the extensive attention necessarily paid to the satisfactory maintenance of the temporary highway, street railway, and train traffic. This involved the construction of a boulevard type detour for highway traffic on private property with the street car tracks temporarily operated between the boulevard lanes. It was also necessary to install a removable span in the temporary trestle over Woodward Avenue to provide for replacing the street car traffic on Woodward Avenue while the final work of raising the railroad grade was completed.

At the present time, highway and street railway traffic is operating over the temporary detour. Permanent concrete sub-structure and structural steel erection are practically complete. It is anticipated that the work will be completed about the middle of September. The general contractor for the work is the W. J. Storen Company, of Detroit, and the contract price is $350,000.

The Highland Park structure is one of 36 being built in Michigan today and one of eleven to be located in Wayne County, the state's metropolitan district.

The End of the Trail

Winter

What Would It Be Without Machines?

A Mountain Pass in Oregon, February, 1936. A Caterpillar, RD8, equipped with Le Tourneau Angledozer, kept the road open. Behind the snow fighter comes a tractor with supplies for a mine.

on the Highways

This Picture Doesn't Show the Plow or Much of the Truck Back of It, But That's Not the Fault of the Machines. Time—February, 1936; Place—Milwaukee County, Wisconsin; Equipment—Wausau "V" Plow and FWD Truck, Model SSU, 4-5 Tons Rated Capacity

Finishing a Job, Geauga County, Ohio. A Euclid Truck with Sargent One-Way Plow on County Maintenance

Widening a Highway in Manitoba, Spring, 1936, with Model 880 Snow King Rotary Plow, Mounted on FWD Model M-5 Truck with Auxiliary Motor.

Widening Out Near Sandwich, De Kalb County, Illinois. Austin-Western No. 1½ "V" Plow Mounted on 2-Ton Dodge Truck. Outfit Owned by Sandwich Township.

Clearing Road Between Dousman and Eagle, Wisconsin, February, 1936. Rear View of an Allis-Chalmers Model "L-O" Pushing a Wausau Plow on First Trip Through.

Opening an Important Route Into Milwaukee. A Bucyrus-Erie 7/8-Yard Gas Shovel at Work on the Drifts.

Province of New Brunswick, Canada. Rear View of a Barry Plow Widening the Road on Its Second Round. The Snow Bank Turned Up by the Wing Is About 8 Feet High.

Near Olin, Iowa. Reopening a Road Which Had Drifted Full After Having Been First Opened by Hand. La Plant-Choate Model V-40 at Work.

Removing Hard, Packed Snow from the Golf Club Road Near Streator, Ill., with an Anthony Safety Snow Plow Propelled by Chevrolet 131-In. Wheelbase Truck. Rate of Working 15 to 20 Miles Per Hour.

Cindering a Steep Grade in Peoria, Ill., December, 1935, with Little Giant All Purpose Spreader.

Loading Truck in New Haven, Conn., with a City-Owned Barber-Green Snow Loader, February, 1936.

In the Town of Phippsburg, Maine, March, 1936. A Model 61 Baker "V" Plow Mounted on 1935 Ford Truck Operating at 15 Miles Per Hour Through 12 to 14 In. Snow.

Cleaning Rutted Snow and Ice from a Street in Rome, New York, with a Rome Motor Grader. Winter of 1935-1936.

Heavy Job with a Snow King Rotary in Southern Wisconsin in the Winter of 1935-1936.

February, 1936, *in Minnesota, with Thermometer Thirty Degrees Below Zero. An Adams Diesel Powered Motor Grader Working Through Drifts Seven and Eight Feet High.*

In Manitowoc County, Wisconsin, March, 1936. *Snogo Plow Cleaning the Road.*

In Racine, Wis., Winter of 1935-1936. *A "V" Plow Propelled by a Case Heavy Duty* 4*-Speed Tractor Is Widening the Road at Left. In the Right Hand View, It Is Breaking a Hard Pack.*

Cleaning Up Drifts in Milwaukee County, Wisconsin, March, 1936, *with a Kochring ¾-Yard Shovel Equipped with a* 3*-Yard Special Dipper*

In the Town of New Berlin, N. Y. Model 40 *Deisel Cletrac. Rear View Showing Wing-Operating Mechanism.*

Clearing a Walk in Negaunee, Mich., with a City-Owned Model E Cletrac Equipped with Sidewalk Plow

Breaking Through a Crust Near Twin Falls, Idaho. A Heavy Snow Followed by an All-Day Rain and Then a Freeze Left a Good Imitation of Concrete. A Caterpillar Tandem Drive Auto Patrol with "V" Plow Is Doing the Business.

A Sidewalk in Evanston, Ill., Being Opened Up with an International I-12 Industrial Tractor Equipped with Baker Straight Blade Plow.

Cleaning Up After a Heavy Snow at Depew, New York, in March, 1936. The Pictures Show Front and Rear of a Huber No. 4 Grader, Operated Without a Snow Plow.

Clearing Drifts Near South Milwaukee, Wis., with a Bucyrus-Erie Bullgrader Mounted on an International TracTracTor.

In Pendleton, Ore., February, 1936. This City-Owned Outfit Comprises an Austin-Western Three-Ton Reversible Plow and a G. M. C. Truck.

On an Outlying Street in Racine, Wis., 1936. Case Heavy-Duty 4-Speed Special Tractor Behind a Frink Plow.

The Town of Cascade, Idaho, 1936. Bucking the Snow with Caterpillar RD6 and Le Tourneau Angledozer.

Breaking Hard Frozen Snow in the Town of Montour, New York, with a Baker Model 130 "V" Plow and an Allis-Chalmers Model K Tractor, February, 1936.

Working Up a Hill Near Elmira, N. Y. An International Industrial Tractor Pushing a Large "V" Plow.

Opening Up in Aurora, Ill., with a Barber-Greene Spiral-Feed Snow Loader.

Smash Goes the Snow on a Minnesota Highway! An Adams Motor Grader Is the Smasher.

Planes Could Land at the St. Hubert Airport, Canada, at Any Time Last Winter. The Barry Model B-30 Plow Made This Possible.

The Use of Dynamite in Settling Fills

THE following summary of explosive methods in highway construction across soft ground was prepared by the Institute of Makers of Explosives, 103 Park Avenue, New York City.

Through the use of explosives, road builders have learned how to save much time in the settlement of highway fills over swamps, boglands and other unstable ground. Now frequently years are saved by the use of dynamite, where formerly it was necessary to apply the fill in several installments while waiting for each layer to settle naturally.

The highway engineer and the explosive expert have worked together in many states devising means by which soft, underlying material can be displaced and the fill settled to hard bottom almost in one operation.

Fill settlement blasting was first attempted about ten years ago. A variey of methods were tried out, and among them three have been accepted generally as standard practice: the Trench Method, the Under-Fill Method and the Relief Method. Experiments in the field are being carried on continually, however, and at any time still newer methods may win favor.

When roads are to be extended over shallow depths of muck, the trench method is the one usually resorted to. Here dynamite again demonstrates its value as a ditching agent because it leaves no spoil banks to be hauled away in trucks or otherwise contended with. Also it has the additional advantage of liquefying much of the surrounding muck not removed by the blast. This allows the fill, if placed immediately, to work speedily to hard bottom, pushing ahead and to the sides of the softened muck, so that often twice as much fill can be applied as the capacity of the blasted ditch would seem to accommodate.

When the relief method is employed, a ditch on either side of the roadway is blasted before the center portion. In this way trenches 45 feet wide and eight feet deep have been blasted conveniently. Although both relief ditches may be fired at the same time, experience has proved that it is better to fire them separately, since then less muck will be deposited on the center strip.

The under-fill method generally is used when it is necessary to settle highway embankments through 12 to 50 feet of unstable material.

This method involves the blasting of the muck from under the fill after the fill has been placed. First, however, the surface, or meadow-mat, of the swamp—generally a heavy, matted root growth, is torn up and shredded by blasting to a depth depending upon the thickness of the mat.

Numerous methods are used for the placing of the dynamite under the fill, but in all cases success depends upon the placing of a maximum of fill before any underfill material is blasted. The heavier the fill, the better, for then the blasts fired underneath will be so confined by the hard bottom below and the solid fill above that the muck will be pushed to the sides, thus allowing the embankment to drop into place on hard bottom.

It is essential to be thoroughly acquainted with the nature of the ground over which any highway fill is to be settled with explosives. The success of the project depends upon soundings taken at frequent intervals along the whole line of the fill, and it is always necessary to know definitely the amount of muck remaining between the bottom of the fill and hard bottom. To this end efficient sounding and sampling equipment is necessary. Several devices are available which permit the engineer to obtain the required information.

Scenes on the Pan-American Highway

WHILE the whole world can be thankful for the friendly spirit among American nations, the international co-operative enterprise from which the scenes below are taken is the especial joy of road builders.

The pictures were taken in the republic of San Salvador on that dream now nearing realization—a modern road from Alaska to Panama. All the countries through which this world's longest highway will pass are bending every effort to finance and construct their portions. The editor wonders what chance a similar project would have in Europe. Since engineers from the United States are generally supervising the work, it is natural that they should employ the roadbuilding methods and the roadbuilding machinery of this country. The photos show Caterpillar diesel tractors and Athey wagons hauling from the Bucyrus-Erie shovel in the cut to the fill where another Caterpillar tractor mounted with a bulldozer spreads the dump.

ROAD RELOCATIONS AND BRIDGES INVOLVED IN POWER AND

Keystone Dam and Supply Canal Are Primary Factors for Successful Operation of Project

SEVERAL successive years of crop failures, coupled with a devastating flood of the Platte River in 1913, prompted a group of public spirited citizens of central Nebraska to sponsor a movement for storing and utilizing, also diverting, flood waters onto farm lands for irrigation purposes. The Central Nebraska Public Power and Irrigation District was organized and a PWA loan and grant approved known as PWA Docket 3400-R. The project involved some road relocation and the construction of many bridges. Relocation of about 30 miles of the Union Pacific Railroad is involved as well as relocation of about the same amount of pipe line.

Core Trench Excavation—Supply Canal near Jeffrey Canyon.

During the years that followed the flood of 1913 surveys were made by local engineers as well as by representatives of the U. S. Reclamation Service. Findings were reported favorably both as to physical and economic aspects. In August, 1924, after an exhaustive investigation of the proposed project, the late Dr. Elwood Mead, Commissioner of the U. S. Reclamation Service, declared the project to be feasible for power and irrigation. Appropriate bills for financing the project were introduced in Congress by Sen. Geo. W. Norris. The bills provided for repayment of funds to be guaranteed by the State of Nebraska. They passed the U. S. Senate favorably but were held up in the House of Representatives and for various reasons the measure was killed.

Subsequently, more thorough and detailed studies were made and the project submitted to the PWA for consideration. An initial allotment of $10,000,000 by the Public Works Administration on September 26, 1935, made possible the commencement of final plans and construction operations. The total cost of the entire project is estimated at $31,000,000. Based upon estimated revenues from power and irrigation sales, it will be possible to amortize the required loan, over and above the PWA grant, in 40 years after completion of the project. Of this total cost the 45 per cent grant will amount to $15,300,000. The balance will be a loan guaranteed by the Public Works Administration. It is not the purpose of this article to discuss individual design features but to describe the project in general.

Description.—The entire project is about 220 miles long from west to east ends. The project originally started as a Tri-County irrigation project (Phelps, Kearney and Adams counties) and is known generally as the Tri-County Irrigation Project. However, the scope of the original plan has been greatly increased to provide storage of flood water and the generation of power and is known officially as stated in the first paragraph. Estimates include the following sections of the project:

1. *Keystone Dam and Reservoir.*—The dam will be

IRRIGATION PROJECT

By VICTOR J. BROWN
Roads and Streets

Adams County Canal, Station 1986, *showing one of county bridges constructed.*

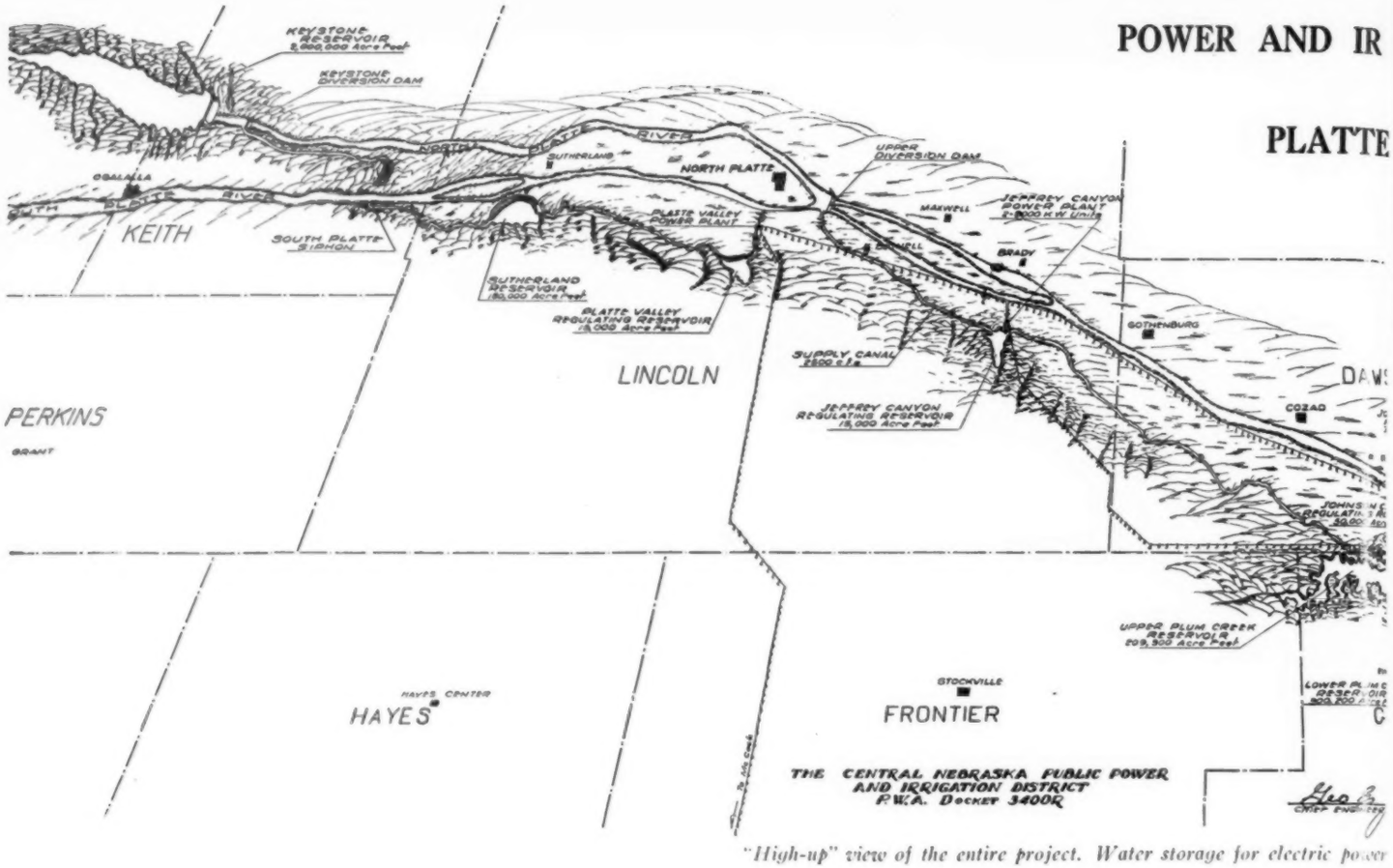
located approximately four miles west of the town of Keystone, Nebraska, and will be approximately two miles long and 160 feet high. The depth of back water will be 140 feet. Approximately 35,000 acres will be submerged and the reservoir will impound about 2,000,000 acre-feet of water. An earth fill dam is proposed, of which the spillway and outlet work will be constructed of concrete. Water released from this dam will flow down the bed of the North Platte River and enough may be diverted by the Sutherland diversion dam (an already completed and operating irrigation project) to insure continuous supply of water to this project. At present, even if the Sutherland power plant were complete, it could not function because their reservoirs are dry. Construction of the Keystone dam will insure continuous operation to this project. The balance of water released, over what is claimed by the Sutherland diversion dam, will be diverted by the upper, middle and lower diversion dams of the Central Nebraska Public Power and Irrigation Project.

2. *Upper Diversion Dam.*—This dam will be constructed approximately five miles east of the city of North Platte, Nebraska. Its crest will be such that the backwater will not in any way affect the aviation field east of the city. Its function will be to divert water from the North Platte River into the supply canal. The waste water from the Sutherland project returns to the Platte River above the upper diversion dam of this project.

3. *Supply Canal.*—This canal will begin at the upper diversion dam and extend through the Jeffrey regulating reservoir and power plant to the Johnson regulating reservoir which is located about 12 miles southwest of Lexington, Nebraska. A wasteway will be provided to return all surplus water to the Platte River.

4. *Jeffrey Power Plant.*—This plant will be located

Keystone Dam Site Looking North on Axis of Dam—Stripping Contract.



"High-up" view of the entire project. Water storage for electric power

on the supply canal south of Brady, Nebraska, and will contain two 9,000 kilowatt generators.

5. *Johnson Power Plant.*—This power plant will be located near the county line of Gasper and Dawson counties, south of the city of Lexington, and will contain two 18,000 kilowatt electric generating units.

6. *Transmission System.*—These power plants will be connected to a 115,000 volt transmission system. One line will extend from North Platte via the Jeffrey power plant and Johnson power plant, passing the cities of Holdrege and Hastings, Nebraska, to Lincoln. One line will extend from the Johnson plant to a point near the town of Miller, thence in an easterly direction to Grand Island. They will be provided with suitable substations and designed for interconnection with the Sutherland and Columbus projects.

7. *Distribution System.*—A secondary distribution system of 34.5 kv. lines has been estimated to be connected to the substations on the 115 kv. lines. These lower voltage lines will extend to the several towns with areas south and west of Hastings which will be served by the Tri-County Irrigation Project.

Dry Bed of Platte River at Lexington, July 28, 1936.

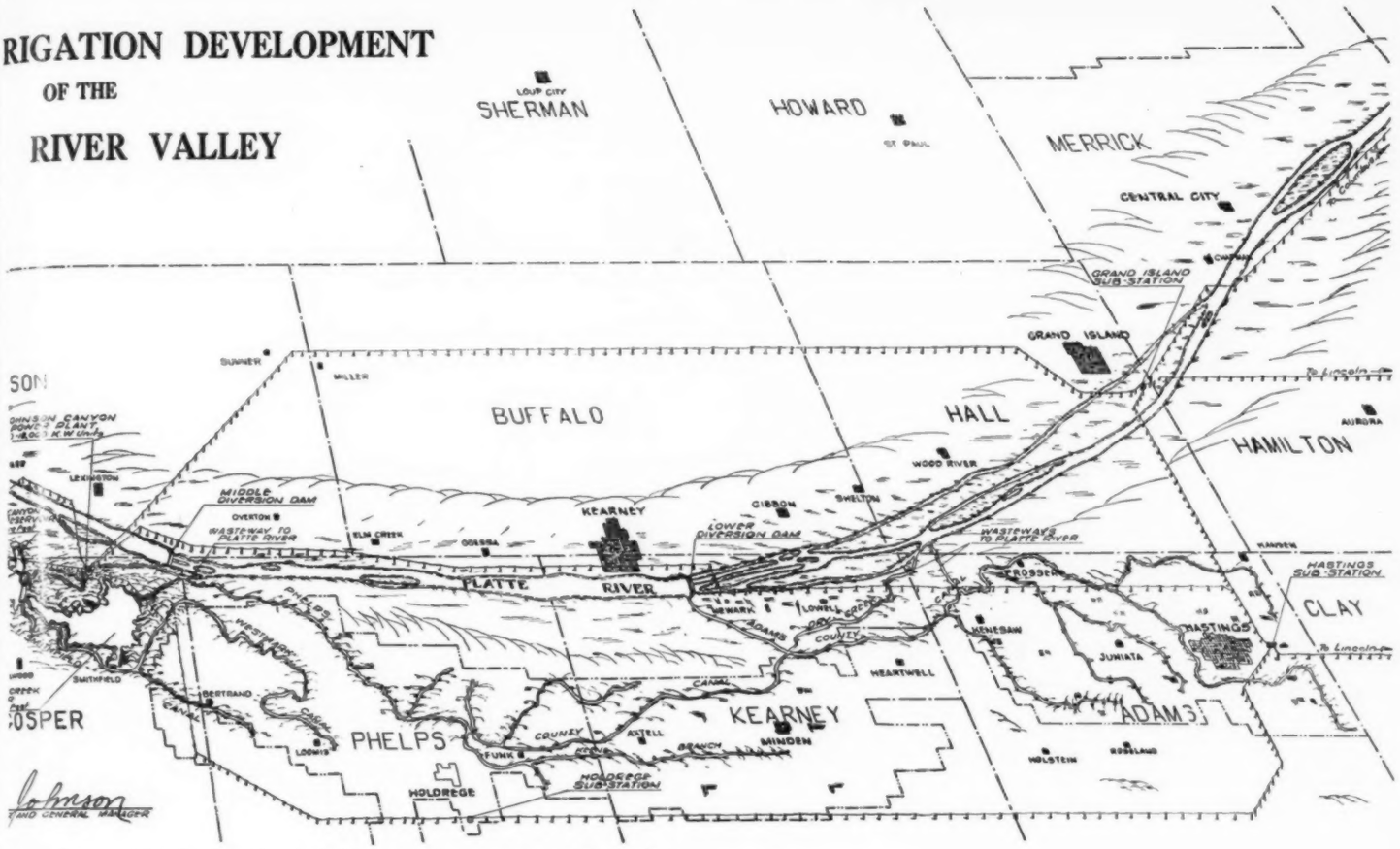
8. *Irrigation System.*—The irrigation system consists of two canals. The Phelps County Canal will serve Phelps and Kearney counties; the Adams County Canal, Adams County. The net acreages to be served are:

Phelps County Canal.....	239,806 acres
Adams County Canal.....	159,453 acres
Total (net)	399,259 acres

In figuring net acres only the land to be served for growing crops has been considered. The Phelps County Canal will receive its water from the Johnson power plant. Water from this plant may flow into the Phelps County Canal or be returned to the Platte River. The Adams County Canal will receive its water from the Platte River through the Lower Diversion Dam, which will be located approximately four miles southeast of Kearney, Nebraska.

General Scheme

The general layout of the entire system, with its relation to other projects, is shown on the accompanying "high-view" map. Unlike the typical flat wide valley adjoining the North Platte River below the Keystone site, the river where the dam will be built is bounded by high bluffs which confine the valley to a width of



generation and later usage for irrigation are the features of the project.

approximately two miles. All water appropriated by the Sutherland project will be intercepted at their Keystone diversion dam and sent through their canal of 2,000 c.f.s. capacity. After passing through their power plant the water is returned to the Platte River from which it may again be diverted for irrigation. Just below the junction of the North and South Platte Rivers the upper diversion dam of the Central Nebraska Public Power and Irrigation District will divert 2,500 c.f.s. to the regulating reservoir of the Jeffrey power plant—28 miles below. Most of the water passing through the Jeffrey plant will continue down the supply canal of 2,300 c.f.s. capacity to the Johnson power plant, the balance being restored to the Platte River to satisfy certain prior rights.

It is the intention of the District to utilize the water leaving the Johnson plant during the irrigation season for irrigation purposes. In order to conserve the water passing through the supply canal and not needed for power, it is planned to provide storage reservoirs at some future date at the Upper and Lower Plum Creek sites. The reservoirs will store 520,000 acre-feet of water. At the tailrace of the Johnson power plant a wasteway will be provided which will return to the Platte River all water not required for irrigation and necessary to be diverted at Kearney for the Adams County irrigation canal. The Phelps County irrigation canal which delivers the water to Kearney and Adams counties will be fed directly from the tailrace of the plant and from the Plum Creek storage. The water for the Smithfield system will be directed out of the regulating reservoir of the Johnson power plant.

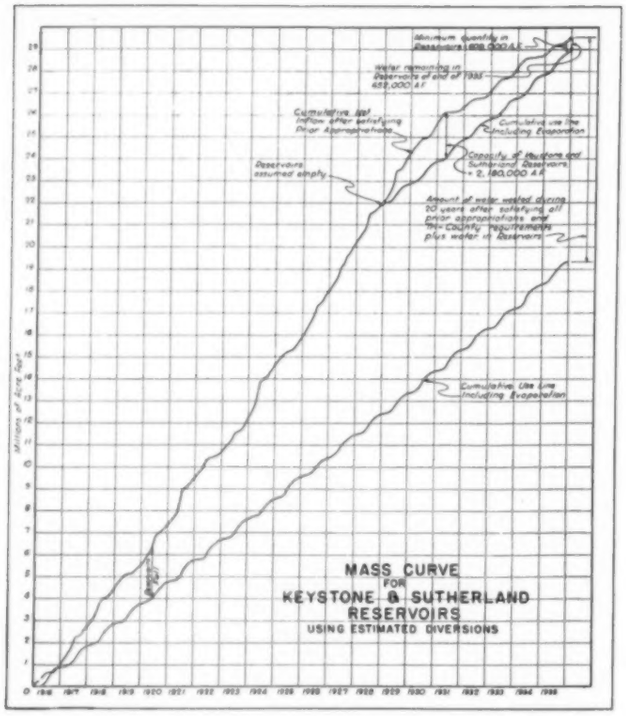
Irrigation

It is planned to construct a sublateral irrigation system to direct delivery of water to each farm. For this purpose the entire region is being surveyed and accurate topographic maps of two foot contours on a scale of 24 inches per mile are being made. Delivery of water will be as follows:

April	5 per cent	July	20 per cent
May	15 per cent	August	20 per cent
June	20 per cent	September ..	15 per cent
		October	5 per cent

The contract price for water rights is $2.50 per irrigable acre per year until such time when the entire loan for the project will be repaid. Thereafter this charge will be based upon actual costs of maintenance

Phelps County Canal, Station 483.



Curves Showing How the Keystone Reservoir Would Have Supplied Sufficient Water Through the Drought if It Had Been Constructed in 1928. *The lower fork on the end of the upper curve is parallel to the assumed demand curve. Seepage and evaporation percentages as calculated by the District are included in the assumed demand curve which is based on irrigating* 500,000 *acres.*

and operation. Flowage of water through the Keystone dam will be regulated by the Nebraska Department of Roads and Irrigation.

At present it is contemplated to irrigate 500,000 acres of land. Allowing for seepage losses, 625,000 acre-feet of water per year will be required for the purpose. To make this amount of water available during each season and to insure availability of water through years of minimum flow in the North Plate River it was decided to construct the Keystone dam to impound 2,000,000 acre-feet. This capacity was deemed necessary from a study of records of flow for the past 40 years.

The Mass Curve for the Keystone and Sutherland Reservoirs shows that the Keystone reservoir, if it had been operating in 1928 would have still had 609,000 acre-feet of water remaining at the end of 1935. It is designed to show that the reservoir is large enough to carry through several years of periodic minimum flow, as well as through years of drouth. The uppercurve is a flow curve of the river. The lower curve is a demand curve assuming that the demand had started in 1918. Seepage and evaporation as calculated by the District are included in this curve. By superimposing the demand curve on the supply curve beginning in 1928 the forked curve as shown is obtained. The difference between the two forks is the assumption of the amount of water remaining in the Keystone reservoir after seven years' operation.

Roads, Bridges, Culverts and Drainage

Throughout the entire project there are numerous small road relocations and many county road and farm bridges and drainage area inlets. Following is a summation of these items as extracted from the District Control estimate:

1. Phelps County Canal and Irrigation System—

a. In Main Canal:

County bridges	$ 69,620.50
Road relocations	960.00
Application of creosote to piling	780.00
Farm bridges	24,650.00
Over-run in farm bridges	3,070.00
Creosote for farm bridges	560.00
Total	$ 99,640.50

b. In Control Structures:

Five highway culverts	$ 13,316.55
Thirteen pipe culverts—cross drains	15,064.75
Sixteen road ditch drains	6,011.34
Fifteen drainage inlet flumes	8,379.80
Thirteen drainage pipe inlets	5,192.40
Eight concrete box culverts—cross drains	29,065.55
Total	$ 77,032.09

c. In Main Laterals:

Thirty-three county road bridges	$ 27,134.96
Farm bridges	4,367.50
One state highway crossing	4,662.55
Twenty-four drainage structures	13,049.00
Total	$ 49,214.01

Summary Phelps County:

In main canal	$ 99,640.00
In control structures	77,032.09
In main laterals	49,214.01
Total	$225,886.10

2. Adams County Canal and Irrigation System—

a. In Main Canal:

County bridges	$ 46,910.00
Road relocations	832.00
Application of creosote to county bridge piling	540.00
Thirty farm bridges	23,700.00
Nineteen farm bridges	10,500.00
Creosote for farm bridge piling	585.00
One railroad bridge	3,500.00
Two county bridges	2,592.00
Total	$ 89,159.00

b. In Control Structures:

Two highway culverts	$ 9,663.25
Seven pipe culverts—cross drains	7,437.15
Eleven road ditch drains	4,436.75
Twelve drainage inlet flumes	7,042.80
Twelve drainage pipe inlets	7,576.70
Eight concrete box culverts—cross drains	26,957.25
Total	$ 63,113.90

Irrigated Corn at Wood River, Aug. 5, 1936.

c. In Main Laterals:

Drainage structures	$ 33,177.77
Forty-four county road crossings	22,647.19
Farm bridges	19,962.50
Two state highway crossings	5,626.50
Total	$ 81,413.96

Summary of Adams County:

In main canal	$ 89,159.00
In control structures	63,113.90
In main laterals	81,413.96
Total	$233,686.86

3. Supply Canal and Regulating Reservoirs—

Drainage inlets	$ 38,000.00
Road bridges	125,296.00
Road relocations	39,034.40
Farm bridges	162,960.00
Total	$365,290.40

4. Keystone Dam and Reservoir—

Railroad siding and construction of bridge	$ 10,000.00
Highway relocation	331,927.00
Railroad relocation	1,068,500.00
Pipe line relocation	104,925.00
Total (note)	$1,515,352.00

Note: The total estimated cost of construction for the Keystone dam and reservoir is $9,997,875.00.

5. Upper Diversion Dam—None.
6. Lower Diversion Dam—None.
7. Transmission Lines and Substations—None.
8. Jeffrey Canyon Power House—None.
9. Johnson Canyon Power House—

County bridges	$ 13,772.00

10. Supply Canal (does not include bridges over Johnson Power Canal)—

Bridges, above Jeffrey Canyon power house, Stations 222 + 11 to 993 + 00	21,560.00
Bridges, Jeffrey tailrace, Sta. 98W	7,800.00
Bridges, Jeffrey wasteway, Sta. 34 + 03 and 82 + 36	6,160.00
Bridges, below Jeffrey Canyon power house, Sta. 31 + 50W to 2017 + 65	78,886.00
Bridges, Johnson Canyon tailrace, Sta. 38 + 72W to 13 + 72E	10,890.00
Sub total	$125,296.00
Road relocations	39,034.40
Total	$164,330.40

11. Lateral Systems—

a. South Branch—Adams County Canal:

One state highway culvert	$ 4,126.50
One railroad culvert	5,802.70
Eighteen county road bridges	11,207.19
One concrete box culvert—cross drains	2,162.05
Four concrete pipe culverts—cross drains	2,814.65
Sixteen concrete pipe inlets	5,651.07
Twenty-three farm bridges	9,150.00
Sub total	$ 40,914.16
Farm crossings (small laterals)	5,695.00
Total	$ 46,609.16

Non-Irrigated Field of Corn Across Road from Irrigated Field, Aug. 5, 1936.

b. Lateral of Phelps County Canal:

Four county road crossings	$ 2,085.00
Six farm bridges	2,337.00
Sub total	$ 4,422.00
Farm crossings (small laterals)	1,604.00
Total	$ 6,026.00

Summary of Lateral Systems:

South Branch	$ 46,609.16
Lateral of Phelps County Canal	6,026.00
Total	$ 52,635.16

SUMMARY OF ROADS, BRIDGES, CULVERTS AND INLETS

Phelps County Canal and Irrigation System	$ 225,886.10
Adams County Canal and Irrigation System	233,686.86
Supply Canal and Regulating Reservoirs	365,290.40
Keystone Dam and Reservoir	1,515,352.00
Johnson Canyon Power House	13,772.00
Supply Canal	164,330.40
Lateral systems	52,635.16
Grand total	$2,570,952.92

The road relocation at Keystone Reservoir is about 40 miles long. This is standard county road with 24 ft. top.

It will be noted that the Plum Creek reservoirs are not included in the District's Control Estimate and therefor not actually considered in the construction.

Drouth Stricken Cornfield North of Hastings, July 25, 1936, in Adams County.

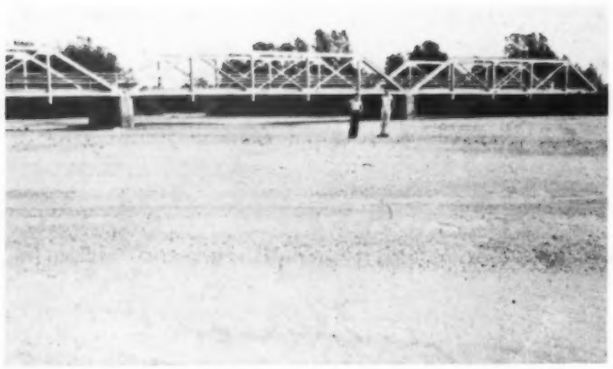
Financial and Legal

To date $4,500,000 have been granted by the PWA. The balance of the $5,500,000 in notes cannot be issued until a court decision on water rights has been rendered. The PWA has approved the project and costs will be handled on the 45-55 per cent arrangement of that authority. However, until water rights are definitely established, and there seems to be no doubt that they will, no construction work can be done on the Keystone Dam.

There are two legal matters up for adjudication: (1) one pertains to water rights and is in the hands of the State Supreme Court; (2) the other pertains to use of waters from one drainage area in another drainage area.

Relative to the first action, when the project was proposed the State Engineer representing the State Department of Roads and Irrigation, on Nov. 2, 1935, granted the right to store water and use it as planned. Opponents of the project carried this decision to the State Supreme Court which reversed the decision of the State Engineer. Their decision denied the water rights as issued and instructed the State Engineer that the application could be amended by the Central Nebraska Public Power and Irrigation District (Tri-County District) as desired. This action would involve long legal procedure so the District asked the Court for a rehearing. In this request they asked the Court to specifically instruct the State Engineer as to how the water rights should be issued to Tri-County.

In the same action the Court was requested to change their decision relative to diverting water from one drainage area into another. The reason for this request lies in the fact that part of the irrigation area lies across a drainage divide from the Platte River. Since irrigation is the life of the people this decision will undoubtedly be reversed.



Dry Bed of Platte River South of Grand Island, July 25, 1936.

These specific instructions are needed from the State Supreme Court before bonds can be issued to continue construction.

Relative to the second action, the power production features have been estopped and results are waiting on a decision of the U. S. Supreme Court in a similar case. The Court has before it the Dieke Power case which involves the right of the government to loan money to political subdivisions of government for building power plants. So far, two U. S. District Courts

Platte River in Flood Stage. Shows Needed Water Being Wasted.

have upheld the government loan feature. The constitutionality of the federal government loaning money to subdivisions for building power plants is the question for the U. S. Supreme Court to decide. The power production feature of the Tri-County Project is economically sound when considered in conjunction with two other power and irrigation projects in the state. The Keystone Dam for insuring continuous water supply will firm-up power from the other two projects.

Decisions from both courts are expected by the first of the year at which time the rest of the contract work will be awarded.

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Public Works Congress at Toronto

The 1936 Public Works Congress will be held at the Royal York Hotel, Toronto, Canada, on September 28-29-30 and October 1.

The Congress is sponsored jointly by the American Society of Municipal Engineers and the International Association of Public Works Officials to stimulate the interchange of ideas and information and to discuss current public works problems.

Further information can be obtained from the joint secretariat of the sponsor societies, whose address is 850 East 58th Street, Chicago, Illinois.

Associated Equipment Distributors' Executive Committee Makes Plans

The annual mid-year Executive Committee meeting of the Associated Equipment Distributors was held July 20, 21 and 22 at the Edgewater Beach Hotel, Chicago. Cooler weather than prevailed during the previous ten days was experienced during the entire period, lending much more enjoyment to the occasion.

While the business transacted pertained chiefly to Association matters nevertheless, considerable time was given during the first day's session by manufacturers and distributors present to listening to the Honorable Robert E. Freer, member of The Federal Trade Commission, Washington, D. C., whose subject was "The Federal Trade Commission's Relation to Business Problems." Mr. Freer's talk was very interesting, and, in the interim between the Executive Committee Meeting and the Association's annual meeting to be held in January, 1937, further study will be made of what the Federal Trade Commission has to offer in aiding in solving some of the major problems of industry, with the idea of possibly making some recommendation for the consideration of the membership at the January meeting. All of the Association's Committees reported progress in their work for the six-month period then ending. The Catalogue Committee revealed plans for issuing the Association's 1937 Catalogue during the fall and winter months. A drive for new members will also be started during the next sixty days.

The organization is looking forward to a successful year under the guidance of President J. S. Gilman, of the W. H. Ziegler Company, Minneapolis. The other Officers and Directors in attendance were:

G. F. Lowe, First Vice-President, Chicago, Illinois.
A. F. Sersanous, Second Vice-President, Portland, Oregon.
A. C. Blaisdell, Secretary-Treasurer, Cincinnati, Ohio.
E. K. Hurst, Sioux Falls, South Dakota.
H. W. Fletcher, New Orleans, Louisiana.
E. S. Jenison, San Francisco, California.
John C. Louis, Baltimore, Maryland.

together with the following members:

Mort Hunter — Victor L. Phillips
O. B. Avery — Hugo Stam.

▼

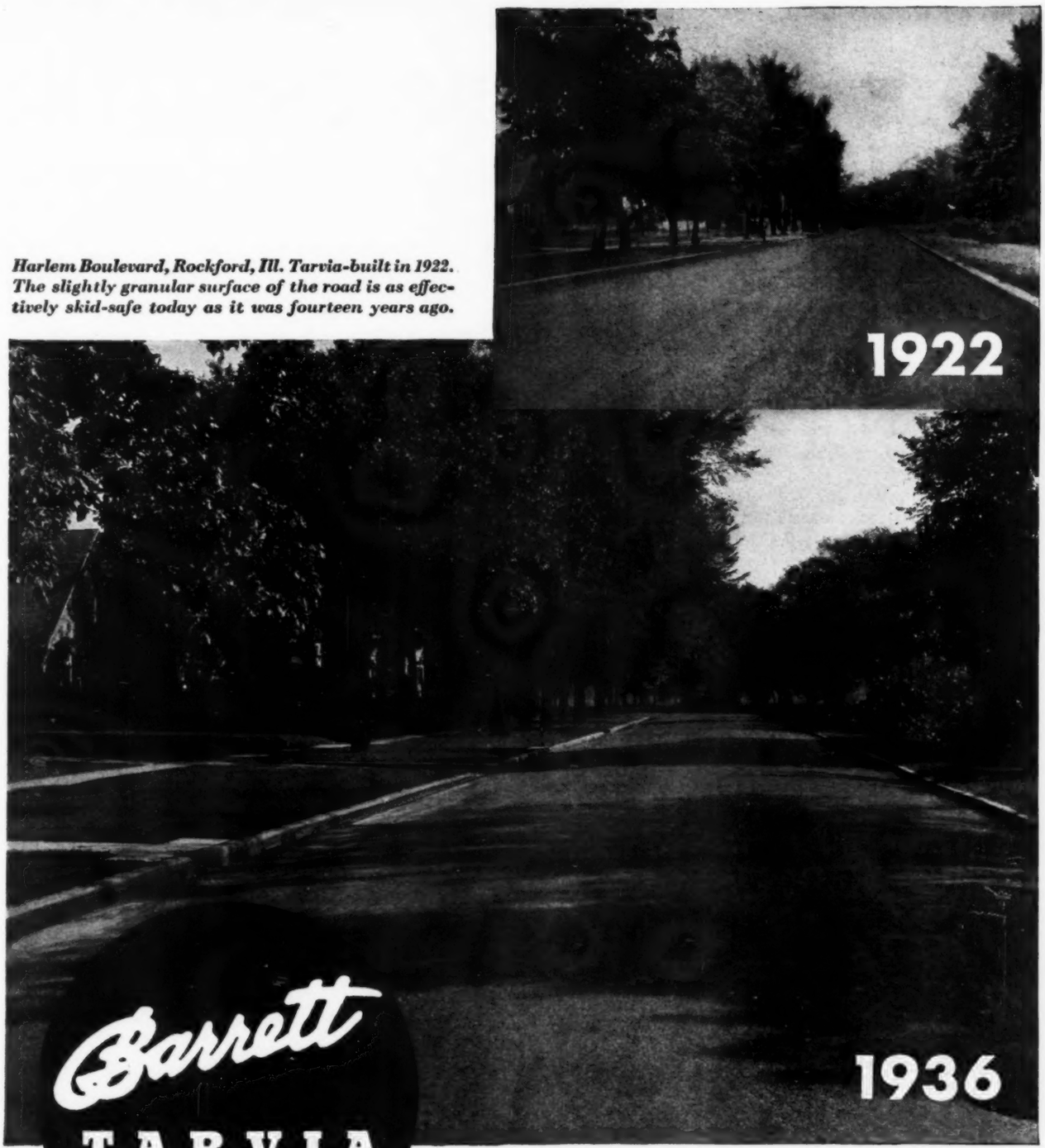
Drive Safely!

Sometimes driving seems to bring out the worst in human nature. Selfishly, a driver will hug the center of the road, refuse to let others pass, weave in and out of traffic, or cut across a line of cars when he wants to make a turn. The courteous driver is the better driver and usually gets places just as fast. He invariably shows his driving ability by adopting good road habits.

Practice courtesy on the road. Many drivers who would not think of being rude to their fellow-men elsewhere seem to forget their good breeding on streets and highways. At this time of the year large numbers of motorists are driving for sheer pleasure. Their right to that pleasure should not be jeopardized by those who consider highway courtesy as the other fellow's concern. Polite motoring makes driving safer and more pleasurable for everybody.

REMEMBER, ON THE ROAD, DISCOURTESY MAY MEAN SERIOUS INJURY OR DEATH. ARRIVE SAFELY!

—*Michigan Highway Condition Bulletin.*



Harlem Boulevard, Rockford, Ill. Tarvia-built in 1922. The slightly granular surface of the road is as effectively skid-safe today as it was fourteen years ago.

Barrett

TARVIA

GOOD ROADS AT LOW COST

Today, more than ever, the need is for *skid-safe* roads. Modern high-speed automobiles, quicker braking and greatly increased traffic place a heavy responsibility upon highway builders. No special method is necessary to make Tarvia roads lastingly skid-safe. Tarvia penetrates deeply, holding the stone or gravel firmly exposed on the road surface to give tires an effective grip that minimizes the skid hazard. Ask the Tarvia field man about it.

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Specifications and Tests for

REFLECTOR BUTTONS

By HARRY E. NEAL
Traffic Engineer, Ohio Department of Highways

THE increasing use of reflector units, or as they are commonly called, "buttons," in highway signs to make them luminous at night under the rays of automobile headlights has emphasized the need for standard specifications and laboratory tests for these buttons to guide purchasers in the selection of buttons having optimum optical and physical properties. The use of buttons in the standard warning signs increases the cost of these signs by an average of from approximately 300 per cent, where they are used to reflectorize the borders only, to approximately 500 per cent, in symbol signs, where the symbols and borders are both reflectorized, to approximately 1,350 per cent in signs having lettered legends with both the letters and the border reflectorized. These figures include the cost of the necessary housings on the backs of the signs for protection of the buttons and the cost of assembling the signs. The buttons themselves constitute from 45 to 75 per cent of the cost of the signs.

In this paper, which is a review of an investigation of reflector buttons made by the Testing Laboratory of the Ohio Department of Highways, an effort will be made to point out the most important requirements for reflector units and to discuss briefly a test procedure to determine the degree to which these requirements are met.

The reflector buttons considered in this investigation were all of the face entry type. As is well known, all buttons of the face entry type consist of a small converging lens in combination with a mirror, both contained within a metal shell. In one group may be placed those buttons in which the mirror is a silvered or chromium plated metal reflector separated from and independent of the lens. In the other group are those in which the back surface of the lens itself is silvered. Both types have certain properties in common but each presents different tendencies to failure under exposure to weather.

The most important requirements for satisfactory reflector buttons are as follows:

1. Satisfactory optical qualities.
2. Satisfactory physical qualities or durability.

The optical qualities to be considered are the following:

1. Brilliance or optical efficiency and uniformity of individual units.
2. Operational range or angularity.
3. Presence or absence of undesired color; i. e., chromatic aberration.

The physical properties which should be considered are:

1. Ability of mirrors, shells and mounting appurtenances to withstand corrosion.
2. Ability of lenses to withstand fracture or to resist the tendency for mirrored surfaces directly on the glass to separate from the glass under extremes of heat and cold.
3. Proper sealing in order to exclude moisture and corrosive gases from surfaces within the shell.

Optical Tests

Reflecting Efficiency.—Tests for optical qualities will be discussed first. In some instances attempts have been made to study the optical properties of reflector buttons by photographing groups of various makes of buttons under automobile headlights at night. The difficulty with this method is that the photographic effect is not proportional to the intensity of the light and varies from plate to plate. It will suffice, however, for a rough comparison of the reflecting ability of several buttons when they are photographed on the same plate.

A much more satisfactory method of measuring optical efficiency, as well as the one most capable of giving reproducible results, independent of the observer, is by means of an optical apparatus using a photoelectric cell as a light-measuring device. In this apparatus light is passed from a high intensity projection lamp through a converging lens and is then incident on the reflector button which is placed on a mounting free to rotate about a vertical axis. A portion of the reflected light passes back to a small mirror placed in front of the condensing lens and thence to a photoelectric cell. The electric current, passing through the photoelectric cell and read on a microammeter, is a measure of the reflected light at the mirror.

In this arrangement the electric lamp and lens correspond to the headlamp of a car and the mirror and photoelectric cell to the eye of an observer. Turning the reflector button through certain angles corresponds to a car being certain distances from the reflector. In calculating the angles and corresponding distances the following assumptions were made:

1. The line of travel of the left headlamp of the car is assumed to be 22 feet from the center of the sign in which the reflector buttons are placed. This assumes the car to be in the center of the inner lane of a four-lane road.
2. The eye of the observer is 6 feet back of the left headlamp and 21 inches above the elevation of the center of the headlamps.
3. The headlamps are 28 inches center to center and have 3-foot elevation above the road.
4. The center of the warning sign is 3 feet 6 inches above the crown of the road.

In making the tests with this apparatus the reflecting abilty of the buttons being tested is obtained by recording microammeter readings for 5-degree intervals rotating the button about a vertical axis from 0 degree to 30 degrees, or until the limit of visibility has been determined. The microammeter readings are then converted to reflected intensities from data previously obtained by calibrating the photronic cell and microammeter.

Chromatic Aberration—The test for chromatic aberra-

tion or presence of color in crystal buttons is determined by visual inspection of buttons in actual field tests when illuminated by automobile headlamps at a distance of 100 feet, and should cover an angular range of 25 degrees each side of the normal and throughout a complete rotation of the button about its horizontal axis.

Physical Tests

The following accelerated physical tests measure the ability of the buttons to retain their efficiency under exposure to heat, cold, corrosive gases, moisture; i. e., actual service conditions.

SO_2 and CO_2 Corrosion Test.—This is a test to determine the ability of the buttons to withstand the corrosive action of gases present in the atmosphere. In this test 15 sample buttons with their respective mountings are placed in a bell jar, placed in a pan filled with water. Ten per cent SO_2 and 4 per cent CO_2 by volume are then introduced into the bell jar and the temperature increased to between 86°-104° F. Each cycle of the test consists of exposure of the buttons to the corrosive atmosphere for 7 hours, washing them in running water for 1 hour, and drying at room temperatures for 16 hours. The buttons are exposed to three cycles of this test, after which their reflecting ability is remeasured to determine the loss in reflecting efficiency, if any.

Salt Spray Corrosion Test.—This test measures the relative immunity of shells, counting appurtenances, and mirrors to corrosion. Fifteen sample buttons are exposed for 70 hours to a spray of 20 per cent (NaCl) in water. At the end of this period the buttons are examined for corrosion or other deterioration of shells, mountings, and mirrors. Their optical efficiency is also measured. This test has no significance except perhaps where buttons are to be used along the sea coast.

Heat Shock and Breathing Test.—In this test 15 buttons are first placed in an oven for one hour at 140° F. They are then removed and placed in water at 50° F. for 15 minutes. After this they are placed in a cold room covered with water, and frozen. After the water has frozen they are removed from the cold room and allowed to thaw at room temperature. This constitutes one cycle of the test. The buttons are examined visually at the end of each cycle for fracture of the lens, separation of lens and mirror, corrosion, and entrance of water into the interior of the button. After three cycles the change in reflecting power is measured.

This test is of value in determining if the lenses are properly annealed since improper annealing sets up strain in the glass lenses and makes them more liable to be injured by sudden impact.

Results of Tests

In setting up the series of tests previously described samples of three well-known makes of buttons were tested. All of these were of the front entry type. Two of these were of the separated and independent lens and metal mirror type, and one was of the type in which the mirror is formed by silvering the back surface of the lens itself. Both crystal buttons and red buttons were tested. Not enough samples were available to permit the drawing of fully defensible conclusions as to the respective merits of the different makes of buttons. However, sufficient information was obtained to point out the necessity for carefully drawn specifications and thorough tests to serve as a basis for selection.

The optical tests showed that there is considerable variation of initial reflecting efficiency between the makes tested.

All of the buttons tested had sufficient practical operational range or angularity. This ranged from 31.5° in one button to 54° in another, the angle in each case being measured between the line from the light source to the button and the normal to the button after rotation about a vertical axis to the point of cut-off.

In two of the makes of buttons the field of reflected light remained circular and without color for all angles of rotation less than the angle of cut-off. The field of the third make of button, however, was a four-limbed figure whose arms rotated as the angle of incident light was changed. In this button coloration of the reflected light was very noticeable.

It was found that the best red buttons had only 36 per cent of the reflecting power of the same size and make of button in the crystal. The actual visibility of the red buttons may be even less than this due to the fact that the sensitivity curve of the photoelectric cell is higher than that of the eye in the red region.

In the durability tests it was found that one make of button was effectively sealed. The gasket seal was effective in preventing moisture and corrosive gases from entering the interior of the shell and affecting the reflecting efficiency of the unit. In another make several samples were found to be ineffectively sealed, permitting the entrance of moisture and gases thus appreciably reducing the reflecting efficiency and the service life.

Conclusions

The optical tests and the accelerated weathering tests described disclosed a considerable variation between reflecting efficiency and durability of the different buttons tested. One button apparently was superior to the others in the most important characteristics. As the prices of the various makes are nearly equal it is therefore the part of wisdom and economy to prepare carefully drawn specifications and to investigate carefully the optical and physical qualities of the various buttons offered.

The specifications, it is submitted, should include the following:

The minimum effective reflected light intensity requirement for each size of button, with the incident light normal to the lens, should be specified. The buttons should have at least 50 per cent efficiency when rotated to an angle of 25° to the right or left.

All buttons should be of the same color tone or shade throughout their angular range, i.e., the minimum of chromatic aberration.

The shells of the buttons, mirrors, and mounting appurtenances should not show detrimental corrosion under the SO_2, CO_2 test and the salt spray test.

The lenses of the buttons should withstand the heat shock test without fracture. There should be no cracking or separation of the mirror from the backs of the lenses in the case of single unit buttons.

The buttons should be sealed with gaskets which will withstand the heat shock test and will not disintegrate thus permitting the entrance of moisture and corrosive gases.

It should be required that buttons from the same lot should have a reasonable degree of uniformity with respect to brilliance and that they should all have the same color tone.—Acknowledgment: The foregoing is slightly condensed from a paper published in "American Highways" for July, 1936.

Construction of Highway Bridge Over Colorado and Southern Ry. at Chugwater, Wyoming

SPEED IN WYOMING

Organization and Adaptable Equipment Expedite Simultaneous Work on Widely Separated Jobs

ON a contract that called for completion of the job within 170 days, Treastor and Peterson of Casper, Wyoming, working under a sub-contract from Blanchard Brothers, whose headquarters are in the same city, are completing a grade separation bridge and a 110,000 cu. yd. approach fill at Chugwater in less than half the time specified.

Begun on May 6th it is expected that this job will be completed late in July.

Dry weather conditions have been a factor in putting this job through fast, but organization and careful scheduling of each step, and the use of the right type of equipment for the job have been far more important.

Treastor and Peterson, in addition to the bridge at Chugwater, have five other bridges under construction across the Belfourche River, and bridge contracts at Gillette, Wyoming. These jobs are located within a 300-mile area, yet in spite of the distance it proved practical to transport certain equipment from job to job, timing each schedule to bring the equipment to the work as required.

The Chugwater bridge project shown in the accompanying illustrations is fairly typical of the other jobs, and has several original features worthy of description.

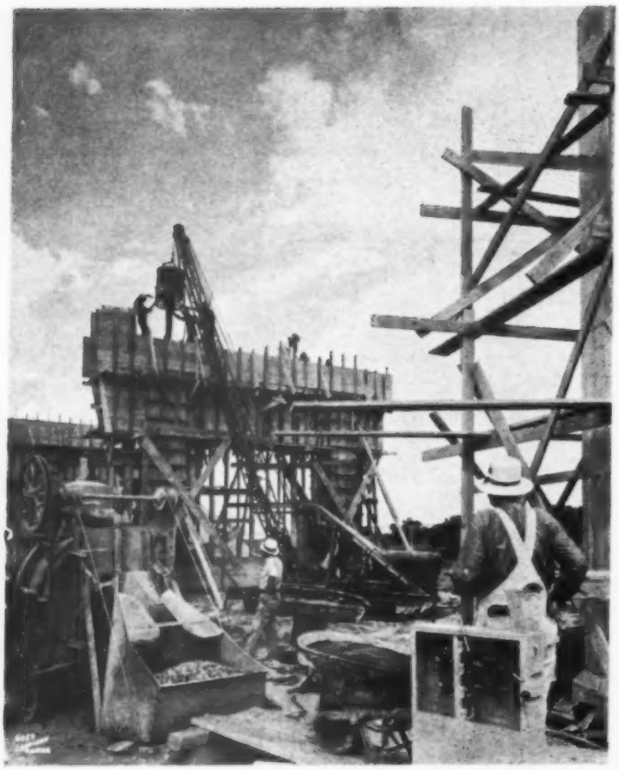
The first step on the project was to develop an ample water supply close at hand, and an Austin-Western Badger crane with clamshell bucket was used to dig two 15-ft. wells in marshy ground. This water supply was used not only for concrete but to soak down the earth on the two approaches as well.

The angle of the railroad right-of-way in relation to the overpass made it necessary to place two of the piling forms close to the 16-ft. clearance required by the railroad. This condition meant that in digging the foundation the road would normally require cribbing to protect the road bed. The contractors' experience on other jobs enabled them to prove to the railroad that the speed of their shovel and clamshell would make it possible for them to excavate and pour the concrete quickly, and at a minimum loss of train time due to "slow orders" over this location if the cribbing job were eliminated. The Colorado and Southern agreed to this suggestion and the excavating work that would otherwise have taken 12 men 3 days to dig was completed by crane and clamshell in one day's time. The muddy condition of the earth which would have been a serious handicap to hand labor proved no handicap to the machine.

As the piling was carried up and the forms were placed for the upper section of the bridge the clamshell was replaced by a dump bucket, which carried the cement to the forms. By following this method of pouring, the mixer and materials had only to be placed in position near the piling, and it was unnecessary to construct any overhead scaffolding for carts or a gravity chute. Here again timing was an important factor. With the mixer working at full capacity and with no delay in batching, the concrete was carried to the form as fast as it could be produced. The result was an even curing of the concrete, and a fast low-cost job.

As shown in the picture the visibility and compact character of the equipment are important factors in the speed and economy of this work.

For the approach fills, borrow was taken close at hand and carried to the job in tandem 12-yard scrapers. The



Speed in Cement Mixing and Pouring. Note the man in the foreground ready to load the mixer while Mr. Peterson at the center of the picture supervises the operation.

heavy clay soil has given some difficulty in obtaining capacity loads, but this has not been a serious handicap.

On each of the Treastor and Peterson jobs equipment, which is only required for certain phases of the work, is shipped from job to job to keep the schedules set for each contract. The crane, along with its 30-foot boom, was moved from job to job on a low bed pneumatic-tired trailer hauled by a truck.

The cost of the Chugwater grade separation will be about $80,000 for the bridge and fills, financed with state and federal funds.

The resident engineer is Mr. Hall, whose knowledge of contracting and engineering thoroughly qualifies him for the work he is doing.

The road, like most of those built in Wyoming, will be a black top construction, the aggregate supplied from local pits and the asphalt from wells and refineries located near Casper, Wyoming.

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Weight of Drifted Snow

Interesting information in snow removal work on the Trail Ridge Road in the Rocky Mountain National Park was given by Clyde E. Learned, Senior Highway Engineer, U. S. Bureau of Public Roads, Denver, Colo., in a paper presented the 1936 Highway Conference at the University of Colorado. This road, said to be the highest through auto route in the country, is a closed for winter highway. In order to open the road to traffic by June 15 it is necessary to start snow removal operations in the fore part of May.

In the opening of this pass, the bureau uses a Park Service rotary snow plow of the auger and blower type. This is supplemented by a number of heavy duty four-wheel drive trucks which are used in the lighter cuts and also to assist the rotary on widening and cleanup operations. In deep packed snow a number of men are kept at work breaking and shooting down the higher drifts so that the rotary plow can handle them. As the weather during May and June above timberline is sometimes very bad, it is often necessary to retard the advance upward and turn back and open the snow-filled road behind in order to move in supplies and get the men to and from work. In clear weather the men must be protected from sunburn and snow blindness, as the glare of the sun on the broad expanse of snow is terrific.

A fairly comprehensive record was kept of the work performed in opening the Trail Ridge route last spring. This included weight determinations of snow, capacity of the rotary plow in various depths and densities of snow, as well as the effectiveness of various classes of explosives. The snow encountered weighed from 6 to 33 lbs. per cubic foot. The average for the new snow in drifts was 12 lbs. while the old packed snow averaged 22 lbs. per cubic foot. The average for the entire mass encountered was approximately 17 lbs. per cubic foot.

In packed snow weighing from 20 to 33 lbs. per cubic foot, the rotary picked up and threw out 1.8 to 6.3 tons of snow per minute. The maximum output was in snow from two to three feet in depth, and the minimum in snow over five feet in depth. In snow ranging from 6 to 14 ft. in depth, the efficiency of the rotary plow was materially increased by blasting, the output of blasted loosened snow from the rotary being fairly constant and averaging about three and one-half tons per minute.

In the opening of the highway a total of 120,000 tons of snow was moved, of which approximately 77,000 tons was old packed snow. The balance of 43,000 tons was new snow which fell or drifted in after operations were started. The entire mass of snow was moved at a cost of approximately 4 cts. per ton. Expressed in units, which may be a little easier for most engineers to visualize, over one-half million cubic yards of drifted or packed snow was moved for a little less than 1 ct. per cubic yard. These unit costs are approximately double the Berthoud Pass unit costs. In both the Berthoud Pass and the Rocky Mountain Park work, the average weight of the packed, drifted and wind-rowed snow was found to be the same, namely, 17 lbs. per cubic foot. The increased cost of the Rocky Mountain Park work is to be expected and was due to the need for explosives and the use of more labor in connection with the shooting down of the high drifts so that the rotary plow could handle them. During the entire period that the rotary plow was in action, the average output was 3.2 tons per minute. This is equivalent to approximately eleven cubic yards of old packed snow, or 20 cu. yds. of newly drifted snow per minute. In general, the observations indicated that the output of the rotary varied materially with the depth of snow but not appreciably with the weight.

The cost of opening this highway the past spring was $4,536, which was distributed 33 per cent to labor; 31 per cent to materials and supplies, which included three and one-half tons of explosives; and 36 per cent to rentals. Although various brands and grades of dynamite ranging from 20 to 60 per cent were used, the results were such that no definite conclusions could be drawn. However, it was demonstrated conclusively that snow should be blasted only a short distance ahead of the rotary plow since blasted snow readily packs again and if left for any period of time, requires reblasting.

Thanks to the WIRE FABRIC

This Highway **will LAST LONGER . . .**
STAY SMOOTHER . . . COST LESS TO MAINTAIN

NOTICE the Wire Fabric in this photograph. Here is a product which has been used for many years and has proved to be one of the most important factors in good concrete paving construction.

Wire Fabric adds strength and endurance to the finished highway—binds the concrete together, making a strong rigid unit with surprising resistance to settling, frost heaves, and overloading. It prevents many cracks . . . and when tiny cracks do start it checks their spread, holds their edges tight and reduces spalling.

American Steel and Wire Company Welded Wire Fabric is specially designed to do this job well. Closely spaced wires provide uniform stress distribution; electric welding insures positive, permanent bonds. In either sheets or rolls, it is available for quick delivery.

To lengthen the life of your highways; to provide a smooth, even running surface; to reduce maintenance costs . . . use American Steel and Wire Company Wire Fabric. It's poor economy to build a highway without it.

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UNITED STATES STEEL

LIQUIDATED DAMAGES VS. BONUS AND PENALTY

By T. H. CUTLER

State Highway Engineer, Jefferson City, Mo.

IN preparing some matters for discussion of the above-mentioned subject, it was my general understanding that there were two general methods for insuring that contracts let would be completed on time; namely, (1) provisions for liquidated damages, and (2) a provision for a penalty if the work was not completed on contract time with a fixed amount of bonus, if the contractor completes his work ahead of the scheduled time.

Most general specifications provide that time is the essence of a contract and that delays in completing the work after the time fixed where caused by the contractor, or in case of default of the ultimate contractor, serious loss and damage would be done to the State and driving public, and further providing that damage due to the failure of having the work completed after the date specified in the contract, would amount to a fixed number of dollars per day, which should be withheld from work earned by the contractor as liquidated damages to the State.

From time to time contractor associations have argued that if we are going to charge liquidated damages, which represent a loss to the State for failure to complete work on time, a similar provision should be given to contractors if their work is completed ahead of time.

I believe there is some confusion in most engineers' and contractors' minds regarding the words "penalty" and "liquidated damages."

A penalty, as the term is used generally in law, means the exaction of payment by way of punishment or coercion.

Thus the term "penalty," when applied to a provision in contracts, means an attempt on the part of one party to collect a stipulated sum from the other party as a penalty or forfeiture for the latter's breach of contract. Quite often the amount of penalty is not governed by the actual damage which might be or which has been suffered by reason of a breach of the terms of the contract. "Liquidated damages," as it is used in law, means a provision in the contract as to the sum to be paid in lieu of performance. It is not simply a sum fixed arbitrarily as a means of securing fulfillment of the contract or as punishment for the breach, but is an evident intent on the part of both parties to the contract to fix in advance the amount of damages that actually accrue if a breach occurred for any reason.

There is no general rule by which such provision in contracts may be classified either as provisions for liquidated damages or penalties. The determination of that must rest upon the facts in each particular case and whether the provision is one for a penalty or for liquidated damages depends entirely upon the context of the contract and the evident intent of the parties, as is shown by the terms thereof.

The distinction between a penalty and a provision for liquidated damages, as the terms are defined by our courts, rests upon three principal tests: First, the language employed; second, the subject matter of the contract; and third, the intention of the parties. These tests are applied regardless of whether the parties in making the contract called the provision a penalty or liquidated damages, since what they call it is not controlling. The whole of their agreement and their evident intention controls the determination of what the clause really is.

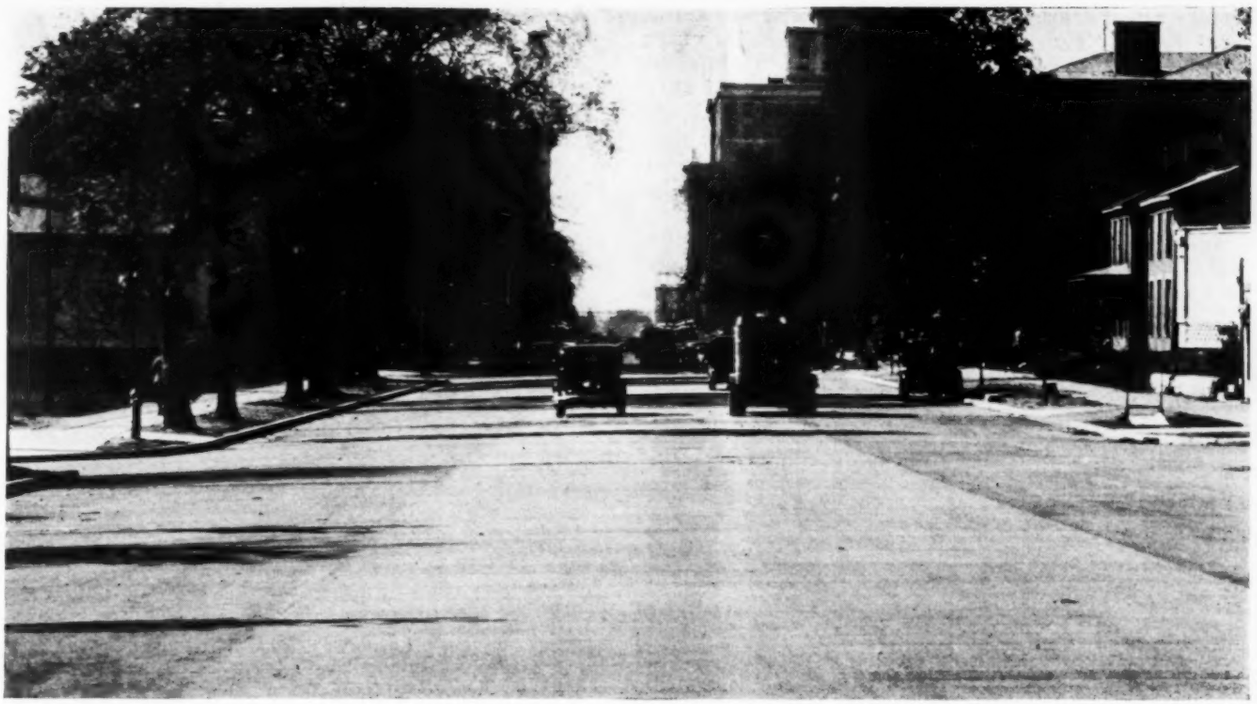
A simple illustration will perhaps give some clarity to the foregoing.

If A should contract with B to pay $50 for B's horse, to be paid within a time certain, and in preparing the contract they should agree that in the event A did not pay the $50 and thus breach the contract he should be held bound to pay B $1,000, that provision obviously would be a penalty, since it is not likely B would be damaged to the extent of $1,000 by his failure to dispose of the horse for $50. In other words, the $1,000 provision was not placed in there with any intention on the part of the parties to arrive at the actual damage which might be sustained by reason of a breach of the contract, but rather the provision was inserted to insure B of A's performance of the contract or to punish A if he failed to perform the contract. On the other hand, where such provisions do not evidence an agreement of parties to punish one for a breach of the terms of the contract, but do show an honest attempt on the part of both parties to arrive in advance at the actual damages which might be sustained by one by reason of a breach by the other, then our courts will hold the provision to be one for liquidated damages. Or where, as it is indicated in the case from which we have quoted, it is apparent from the contract itself that it would be impractical or impossible to fix in advance the actual damages which might be suffered by a breach, then our courts hold the provision to be one for liquidated damages and to be enforceable according to its terms.

I have made a search to see if there is any authority to the effect that where a construction contract has a provision that in case the work is completed ahead of time a bonus will be paid per day equal to the damages specified per day in case the work is not finished by the completion date. I cannot find any hint that the fact that the contract has a provision for a bonus will affect the usual rule that the courts will not enforce the penalty.

Courts seem to hold that the parties to a contract may not agree before the breach that in case of breach the actual damages shall be settled for an entirely different and unrelated amount. This seems to be one exception to the general rule that people can make whatever contracts they desire.

While the parties cannot agree in advance upon some sum which is wholly unrelated to the actual damages which may result from a breach and is therefore a penalty made for the purpose of forcing performance, yet they may agree upon what the actual damages will be in case of breach of contract. This is allowed in cases



The first link in Peoria's "Major Street Plan"..... CONCRETE

Peoria's improved Jefferson Street provides four 10-ft. traffic lanes and two 8-ft. parking lanes. Concrete slab planned to carry 70% of north and south traffic through the business district as well as the traffic on State Route 29. E. O. Pearson, engineer for City Planning Commission; L. D. Jeffries, city engineer; Hartman and Clark Bros., contractors.

Carefully and scientifically Peoria has set up a "Major Street Plan" designed to handle not only today's traffic, but that of the future.

With the findings of a CWA traffic survey at hand, it was determined that the first step in this long-term program should be the improvement of Jefferson Street with a 56-foot pavement. With a knowledge of concrete gained not only on its own streets but also on hundreds of miles of surrounding Illinois highways, Peoria chose the safest, most economical and most universally preferred pavement.

Concrete is the ideal material for permanent street improvements. Its smooth, non-skid surface is safe to drive on, wet or dry. Its light gray color increases the effectiveness of regular street illumination and of car lights. It adds to property values; is always clean and pleasing in appearance.

Concrete is definitely a *de luxe* pavement—yet it actually costs *less* than any other pavement of equal load-bearing capacity. Of course concrete costs far less for upkeep. Plan street improvements in your community with safe, satisfying concrete.

PORTLAND CEMENT ASSOCIATION

Dept. A9-28, 33 West Grand Avenue, Chicago, Ill.

where actual damages would be very difficult to ascertain and prove. The sum named for liquidated damages must be a sum arrived at in good faith as representing what the actual damages would be if they could all be ascertained and proven. It may be that after the breach the actual damages will be either much greater or much smaller than the sum named for liquidated damages in advance. The recovery will be the liquidated damages rather than actual damages, and proof of the actual damages has no place in the case, but this is bottomed on the assumption that as looked at before the breach the liquidated damages were what at that time appeared to be the proper amount. The fact that later events may prove that amount wrong does not affect the validity of the contract if that amount appeared proper at the time the contract was entered into.

One of the tests which has been often applied is whether the amount of damages named in the contract is the same regardless of what the breach might be, or what breach of several possible ones might occur—some of which would be very damaging, others of minor consequence.

The foregoing is taken from the July issue of American Highways.

Grover C. Dillman Honored for His Work on Michigan Highways

Grover C. Dillman, Doctor of Engineering, President, Michigan College of Mining and Technology, Houghton, Mich.

First civil engineer to head the Michigan College of Mining and Technology, Grover C. Dillman was inaugurated August 6 and was then granted the honorary degree of Doctor of Engineering in recognition of his achievements with the Michigan state highway department from 1914 to 1933. During the last four years of this time he was its commissioner. To his credit is the largest highway and bridge construction project yet undertaken by the state, and also dust-laying and snow-removal programs preceded by extensive research.

The D. Eng. degree was also conferred on Nathan S. Osborne, Michigan Tech alumnus and former faculty man who, as U. S. bureau of standards physicist, has won recognition by researches on ammonia and steam.

The installation and degree conferment exercises comprised the formal part of Michigan Tech's three-day Golden Jubilee. The institution was founded as the Michigan Mining School in 1886. It was expanded into a general engineering college in 1927.

37 Michigan Maintenance Employes Injured in Snow Removal Work.—The heavy snow storms of last winter in Michigan took their toll in human suffering as well as in increased maintenance expense. There was an increase in injuries to maintenance employes of more than 200 per cent during February of this year as compared to the same period of 1935. Most of this increase is directly due to the unusually severe weather conditions of the last winter. There were 37 injuries reported for maintenance employes during February, 1936, and 11 for the same period of 1935. All reported injuries were suffered while on duty.

A Few People Constitute Our Main Highway Menace

The August issue of the monthly news letter issued by the Construction Section of the National Safety Council contains a review of an article in a popular weekly which is of such direct interest to everyone concerned with the use or construction of highways that we reprint it below in full:

"BORN TO CRASH" is the title of a very illuminating article on highway safety published in the July 25th number of Collier's Magazine. The author is H. M. Johnson, Professor of Psychology, American University, and Chairman, Committee on Psychology of the Highway, National Research Council. Mr. Johnson comments on the highway safety problem in general and then tells in some detail of the manner in which four large companies which employ about 1400 drivers solved their own particular highway accident problems. These companies, after experimenting with all of the usual methods such as safety campaigns, meetings, courts of inquiry, etc., found that the apparent solution to their own problems was the replacement of a small part of their drivers, approximately 12½ per cent, who were apparently "accident prone" and were causing from 75 to 80 per cent of their accidents.

One company in particular designated as Company "A" reduced its accidents from 204 per year to an average of 45 per year and increased its average number of miles between accidents by 4.57 times in five years.

Of particular interest to members of this section is the fact that in the four companies under consideration in any single year, 5 per cent of the drivers have about 30 per cent of the accidents, 10 per cent of the drivers have more than 50 per cent of the accidents and about 75 per cent of the drivers have no accidents. In general the policy of these companies forbids the discharge of an employee except for gross inefficiency or dishonesty. Accordingly these "accident prone" drivers were, where possible, transferred to jobs other than driving. Now instead of having traffic accidents they had personal injuries. An analysis of the records of more than 2,000 drivers employed by the four companies showed that their automobile accidents and their personal injury cases tended to accumulate equally. Another point of interest is that among the drivers who left the employment of these companies and continued to drive, either for themselves or for another employer, those of whom information is available continued to have accidents in about the same regularity as before.

Mr. Johnson also states that in his opinion no satisfactory test has yet been developed for determining before hiring or before granting a license to operate, whether a person will become an "accident prone" driver.

If the opinions expressed in this article are correct, as they undoubtedly are, it would appear that there is a very strong possibility that a large percentage of occupational accidents in general and construction accidents in particular happen or are caused by a comparatively small group of employees known as "accident prone." It would appear to be to the interest of the employer as well as the follow-employees of these "accident prone" employees to eliminate or transfer them to less hazardous occupations.

In a manufacturing plant with low turnover it would be comparatively easy to determine just who these individuals are and make some provision to render them less hazardous to themselves and others. However, in the construction industry, where jobs are usually of comparatively short duration and a new crew is employed in each locality the problem would appear to be more difficult. Mr. F. I. Rowe, Vice Chairman for Highway Construction of this section, suggested some time ago a solution for this problem. This was that men who followed construction work should be given an employment record card which they would present on applying for a job. This card would be in the nature of a recommendation, containing remarks by the company employing him previously and in particular containing a record of the accidents which they had sustained. A great deal could be accomplished along this line by contractors' associations in certain localities and some very interesting statistics developed.

Road Oil and Asphalt Congress

The Fifth National Road Oil and Asphalt Congress will be held at Tulsa, Okla., on October 8 and 9. Further information may be obtained from the American Petroleum Institute, 50 West 50th St., New York City.

Observations by the Way

By A. PUDDLE JUMPER

¶ New York City is certainly expediting automobile traffic. They have taken up street car lines on many streets and substituted buses. Again, Chicago please note.

• •

¶ Local residents of the Town of Charlestown, New Hampshire, are watching that half mile stretch of road stabilized with calcium chloride quite closely. They feel it holds possibilities for them for the rest of their town road system.

• •

¶ Those aluminum painted bridges and guard rail posts in Iowa certainly add a factor of safety to night driving. They showed up well even in the heavy rains. I noticed them just north and south of Indianola. Next day I saw another stretch west of Creston, Iowa. Next to a reflectorized button on each guard rail post, the aluminum paint is best.

I have just read "Observations By The Way" in your August issue and note the item regarding advertising signs.

You are absolutely correct, and as for the State of Michigan, the condition mentioned is adequately covered by law. However, many counties fail to appreciate the hazard created by advertising devices and allow them to remain.

This county has earned for itself among advertisers the reputation for being an unprofitable area in which to operate as all county road employes are instructed to remove any advertising device found within the highway limits and therefore it is unusual for any sign to remain in place more than one or two days.

It is surprising how this information will spread and how few signs must be removed.

We recommend the procedure—not as a drive to last a few days, costing a large sum of money, but every working day which inconveniences no one but advertisers.—*K. L. Hallenbeck.*

[Mr. Hallenbeck is Superintendent and Manager of Washtenaw County Board of Road Commissioners, Ann Arbor, Michigan.]

¶ At Middletown, Connecticut, the state highway department is building a large bridge across the Connecticut River from Middletown to Portland. I saw a new construction outfit there the likes of which has never been used before. It is, in theory, an immense core drill. The accompanying

picture shows how the rig is set up. The core cylinder is 10 feet in diameter and the one shown in the picture was 110 feet high. It eliminates the need for a cofferdam or caisson in building the foundation for the abutment. A complete story on this outfit will appear in a later issue of ROADS AND STREETS. Merritt, Chapman and Scott are the contractors.

• •

¶ Imagine the consternation of a through traveler driving on U. S. No. 1 through Pennsylvania to be confronted by countless signs—"Begin Twenty Mile Speed Limit." It seemed to me that I never would get away from those signs. Furthermore, the signs are hard to follow. I suggest a program of resetting and placing of additional new signs. Names of towns should be posted on outside edge of each town, too.

¶ It's getting time to check up on your snow removal equipment. Have you got enough to keep all roads clear?

• •

¶ Rambled up into Michigan to try out some of Commissioner Van Wagoner's curves and tangents, but he didn't fool us once. Those roads are easy to take and easy to keep. Hope to get a larger sample next time.

• •

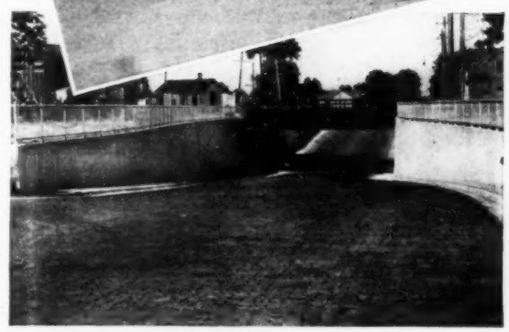
¶ The signing of main routes through Pittsburgh, Pa., is very poor. The signs are placed so high upon poles that automobile lights never strike them. The through driver easily masses his route if he misses just one of those elevated signs. Why not make a WPA project for correcting these poor signing conditions?

There is one comment with which I certainly cannot agree and that is the criticism of the signing system on the Ohio roads. This state has always had the reputation of having the best numbering and marking system in the country. As you know, I get around myself and I am firmly of the opinion that it deserves this distinction. No doubt you had a reason for your criticism and I would be pleased to learn why you have this poor impression of the Ohio signing system.

Regarding your comments on Ohio's poor roads, it should be remembered that there is no state in the Union that has more severe traffic conditions to contend with than the Buckeye State. Centers of population and industry are scattered in various parts and the state is traversed by four of the Transcontinental, East and West U. S. Highways. It had begun the construction of a highway system a number of years before most of its neighbors and for this reason many of the roads now need to be relocated and reconstructed.—*G. F. Schlesinger, Engineer-Director, N. P. B. A.*

[Mr. Schlesinger is Engineer-Director of the National Paving Brick Association.]

FOR UNDERPASSES ...where traffic is brutal



(Top) *Big Four on U. S. 40 near Columbus, O.;* (Center) *Atlantic Coast Line, Bainbridge St., Richmond, Va.;* (Bottom) *Sangamon Ave., Springfield, Ill.*

● **Underpasses impose unusual and severe service conditions on pavements. Pave them with brick.**

Concentrated Traffic

On underpasses there is a concentrated traffic of both trucks and fast moving vehicles. Often there is street car traffic. Repairs to pavement in this vital spot discommodes traffic for miles around and means using hazardous grade crossings. Brick pavement can stand the punishment, without failure.

Unusual Moisture Conditions

Then there are unusual moisture conditions and poor drainage due to depressing the grade to obtain headroom. A brick surface is non-absorbent—moisture and freezing do not affect it. Moisture is sealed away from the base. Brick protects against damage from the elements as well as from traffic.

The brick pavement will not be damaged by quick braking or rapid acceleration of heavy loads. An underpass, so paved, will give long, trouble-free life.

Send for free brochure describing the use of brick pavements for underpasses. Write National Paving Brick Association (Affiliated with Structural Clay Products, Inc.) 1245 National Press Building, Washington, D. C.

BRICK

FOR NEW CONSTRUCTION OR RESURFACE JOBS

¶ Mr. County Supervisor or Commissioner, if you haven't appointed a competent highway engineer do so now or you will not get the benefit of federal aid to counties on your farm-to-market roads. You know that Congress authorized $25,000,000 of federal funds for the fiscal year 1938 and 1939 in the Hayden-Cartwright bill. Counties have to match funds that may be allowed to them. But you won't get those benefits if you don't have or establish competent engineering supervision over your county road construction and maintenance work.

• •

¶ A. Puddle Jumper happened along a detour road just west of Kenosha, Wis., very shortly after a big Nash sedan had hurtled over the end of a culvert on a sharp turn on the detour. The night was rainy and dark. The road had been treated with a bituminous material and was in good shape. The main cause I could see for the accident was one which is quite common in most of our states — Inadequate Signing.

• •

¶ A badly needed territorial plan is one for facilitating traffic movement from Washington, D. C., clear to Boston, Mass. All cities should be either by-passed or routed over wide, 45-mile-an-hour speed limit, thoroughfares or boulevards through the cities. I suggest that the U. S. Bureau of Public Roads organize such a commission.

• •

¶ I saw a novel idea in separation of traffic lanes on bridges the other day. It was on the upper deck of the Queensborough bridge at New York City. A space about three feet wide, 18 inches on each side of the traffic line, was raised about two and one-half inches above the traveled surface.

• •

Congratulations, New Jersey, on the good roads you are building. The whole road from Washington, D. C., to New York City should be wide like that strip from Camden to New York. Pennsylvania and Maryland have let the traffic problem get ahead of them.

• •

¶ Prime mover power for snow removal equipment has changed models so often that each snow plow sale nowadays has necessitated a special manufacturing job.

¶ On U. S. Route 62 near outskirts of Sharon, Pa. Driving a pressed steel guard rail post with pneumatic jackhammer.

¶ Both engineers and contractors on the New York State parkway systems deserve a note of commendation on the excellent work exhibited on those high speed parkways. Skillful artisanship is exhibited in the smooth driving surfaces and uniform expansion and longitudinal joints. I saw very few cracks in the concrete slabs.

• •

¶ I wonder if those who travel over that long elevated highway, the General Pulaski Skyway, through Jersey City, N. J., and its environs to the Hudson River have taken time to send a word of commendation on the project to the State Highway Commission of New Jersey? I remember the old routing that took hours to travel over to get to the ferries in Jersey City. The General Pulaski Skyway permits rapid entrance to downtown New York—a worthy project.

• •

¶ For a good road west between Boston, Mass., and Albany, N. Y., I suggest Route 9. Massachusetts has laid an open texture, large aggregate type of black top road on this route that is wide, smooth and safe. I drove through rain part of the time up and down those mountains and the tires never slipped once. West out of Pittsfield there is a grand concrete road, well marked, and wide enough to accommodate the heavy traffic.

There were over 300 Wisconsin Highway Commissioners and County Highway Committee members in attendance at their Midsummer Meeting held in the Eagle's Lodge at Kenosha on August 20 and 21. Cooperation between the counties and the state highway commission was the keynote of the meeting. This meeting was a joint gathering of the highway commissioner's association and the highway committee members' association of the counties. In a vacant lot across the street was a display of road construction and maintenance equipment. I suggest a hall with better acoustics be selected next time. I could hardly hear Mr. Thomas J. Pattison, Secretary of the State Highway Commission. It was muggy and rainy so that A. Puddle Jumper was really jumping puddles —on foot.

• •

¶ "The height of something or other" is the recklessness indicated when a new car shot past me on a Nebraska road. It was going about 75 or 80 miles an hour. I was traveling about 50 miles an hour and this car made me feel like I was tied to a post. The car cut in directly in front of me to avoid a car coming from the opposite direction. I had to jerk my steering wheel to the right to give the speedy "cutter-inner" clearance. About a mile down the road I saw the same car pulled up alongside a hot dog stand and the young punk driver was setting on the running board licking an ice cream cone. John Wheeler, Indiana Highway Commissioner, please note. What would you feel like doing to that kind of motorist?

• •

¶ A. Puddle Jumper was doing a first class, A-1 job jumping puddles across Iowa last Saturday afternoon and evening. The state was visited by heavy hail, wind and rain. While many motorists pulled off to one side of the road, others like myself pushed ahead. The drainage system on Iowa's roadways worked exactly as planned.

• •

¶ That double center line on Iowa's highways automatically insures clearance of passing cars. The psychological reaction to the double center line keeps lanes of opposing traffic about 3 feet apart.

• •

¶ U. S. Highway No. 5, north of Bellows Falls, Vermont, is a first class forest fire lane.

EDITORIAL

Quarter Point Cracks

IN a recent issue of ROADS AND STREETS, A. Puddle Jumper commented upon long cracks he had noticed in concrete pavements along the quarter point. The question was raised as to whether or not engineers are completely familiar with all the forces at work in a concrete slab. It is suggested here, again, that concrete paving slab designs be investigated to see why some slabs crack with long longitudinal cracks along the quarter point and other slabs do not.

A suggested beginning of this study would be a comparison of the designs of the following two roads:

1. The stretch on U. S. 34 in Nebraska for several miles north of Union.
2. The stretch on U. S. 34 in Nebraska for several miles west of Union.

The first of these is uniformly cracked on the quarter points on both sides of the center line joint for several sections at a time. The second one is not cracked at all.

The next comparison suggested is to compare item 1 above with the Iowa design on U. S. 34 across the state. There are no cracks at all in the Iowa design. Then a comparison should be made with item 1 and the Wisconsin and Illinois concrete pavement designs. The writer is of the opinion that those cracked sections are caused by a definite force which was not considered in the original designs. A thorough engineering investigation should be made by some highway engineer or a committee of engineers and a report rendered on the findings. This should be done in the interest of the development of highway slab design theory and practice.

▼

Are You Ready for Winter?

IN the fall of 1880 the editor's parents left Rochester, Minnesota, by "railroad train" to establish a home and a general merchandise store in the new town of Elkton, Dakota (no N. D. and S. D. then; just one big state)—distance approximately two hundred miles. Thirteen weeks later they reached their destination. That period, aside from the few hours of actual travel, was spent snowbound at a way station. From time to time rumors came through from beleagured Elkton and other points; rumors of starvation—fortunately false for the most part—for the people ground their wheat in coffee mills and by other improvised means to make a flour which, if not up to commercial standard, was at least nourishing; rumors—also false—that the store building had been pulled down for firewood; rumors—not all false—of tremendous suffering. When the first car of goods arrived and was run onto the siding, the storekeeper and his clerk opened it and sold direct from the door at a rate they never equalled in their permanent quarters.

Those might be termed the latter days of the pioneer era: they seem far away—almost legendary—and yet the difference now is only in degree. Less than twelve months ago many small communities which would resent the epithet "isolated" were cut off for days—a few for weeks—and the reason was the same as in 1880: transportation (this time highway transportation) was not equipped to meet extreme conditions. Again there were economic loss, discomfort, danger, suffering. Nor was 1935-1936 the only recent winter in which such things happened: only four or five years ago half a bus load of school children perished on a snow-blocked road: and almost *every winter* brings the tale of hardships.

Without presuming to summarize the economics of the case for the railroad of fifty-six years ago, we may fairly say that its loss of business plus the cost of the labor gangs with which it fought an unprecedented succession of storms would have paid for a vast amount of equipment. The losses of those depending on the railroad would have paid for a great deal more.

What were the costs of last winter's storms to street and highway departments and to those to whom highways transport is vital? None can say, but again we know they were great; and however trite this emphasis may be, we offer it again because of its importance. In February and March, when the crisis came, the supply of snow fighting equipment was quickly exhausted and all sorts of expensive makeshifts were introduced. Clearly, more thorough advance preparation would have saved money.

It is not sufficient that highway officials and employes work whole heartedly—often heroically—through prolonged crises. This year our state, county and city maintenance departments should be put on a better winter basis, before cold weather strikes; for with all hope for a mild season, there is at least an even chance of a hard one.

▼

Here's An Idea!

FROM California comes a suggestion with a lot of practical common sense, reminiscent also, of the historic effort of Gilbert and Sullivan's Mikado to "make the punishment fit the crime."

A Pasadena citizen proposes that the cost of policing the roads be made a charge upon the drivers who require it.

To this end he would provide that the cost of such policing be paid out of a general fund to be created by the issuance of drivers' licenses which would be renewed annually, like automobile licenses Each year the funds necessary to maintain the highway police would be pro-rated and distributed among the motorists of the state according to the amount of policing each driver has required.

The driver who has been guilty of no traffic violations in the course of the twelve months would pay a very nominal fee or no fee at all. According to a schedule of offenses which would have to be worked out, careless, negligent or lawless motorists would pay fees commensurate with the amount of policing they received. Upon conviction for any traffic offense an endorsement would be made on the back of the driver's license and at the end of the year this would indicate the amount he would be obliged to pay for a renewal.

There are a lot of conscienceless citizens, as well as some merely suffering from *impaired* conscience, whose driving would be greatly improved by such a law reasonably enforced.

This does not take account of the morons. They fall, for the most part, in another category requiring other means of control.

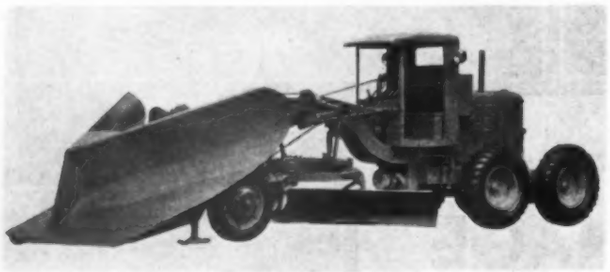
NEW EQUIPMENT AND MATERIALS

Adams Introduces New Motor Grader Snow Plow

A new "V"-type snow plow for use on highways and city streets has been announced by J. D. Adams Company of Indianapolis, Ind. The plow as shown here is mounted on an Adams Diesel Motor Grader No. 51.

The plow has an effective cutting width of 11 ft. 6 in. In installing, no special holes need be drilled or extra work need be done on the grader.

The plow has been designed to secure light weight, balance



New Adams Plow

and strength, and is curved to handle the maximum amount of snow with a minimum of power. The manufacturers claim it is the largest ever built for use on a motor grader and that it will handle more snow than was ever before possible with any motor grader.

In raising and lowering, the plow always remains parallel to the ground, so that in any position the front and back are an equal distance from the ground. The plow may be raised 14 inches off the ground to clear obstructions.

Three shoes, one on each side and one on the front, combined with a hinge arrangement, permit free oscillation on bumpy and rough going. This allows the blade to conform to the contour of the road at all times.

The height of the plow is 42 in. in front and 78 in. in rear. The cutting edges are readily interchangeable.

▼

Two New Convertible Shovels

The Northwest Engineering Co. of Chicago announces two new sizes of convertible shovels.

These models are ⅜ and ½ cu. yd. capacities and are to be known as Models 15 and 18 respectively. They are full revolving and are mounted on full length crawlers. The cab is a complete enclosure with space all the way around the operating machinery and giving ample inspection room and working space for maintenance. The front part of the cab is cut away to assure full vision to the operator.

The operating machinery is mounted on a rotating base casting of unusual design. Both base and side frames are cast as a unit. This assures maintenance of alignment of all shafts and bearings and provides a rigid frame for the operating machinery. The crawler base is also mounted on a casting and all travel gears are fully enclosed both top and bottom. Crawlers are of standard Northwest design, having bronze-bushed, enclosed-drive sprocket shaft bearing, roller-chain drive, with standard self-cleaning crawler tread and roller construction. Side frames are all welded.

The engine is an 8-cylinder Ford truck model with starter equipment as standard. This engine has been improved to meet the more rigorous service of shovel operation by several features that have been found necessary over a period of years. Ford pumping equipment which consisted of only an impeller has been replaced by oversized water pumps. The radiator is of special double tank capacity. The Ford transmission has been replaced by Twin Disc clutch and beyond this is a flexible coupling. A special flywheel is mounted in line with the crank shaft so that none of its torque is transmitted through the engine clutch.

The transmission is through a set of wide-faced helical gears mounted on anti-friction bearings and running in an oil-tight case. All high-speed shafts are mounted on ball or roller bearings. Standard equipment includes the "feather touch" clutch control, which utilizes the power of the equipment to shift the clutches, thereby increasing the ease and speed of operation. Standard equipment also includes the cushion clutch, a device on the main clutch in the hoist drum. This limits the hoist-rope pull to a definite value, transmitting the full engine power but reducing

Northwest Models 15 *and* 18

maximum stresses on every part of the machine under power when the hoist rope is tensioned.

The boom is of wide base design and is all welded. Dipper sticks are also welded. The bucket has a manganese front with removable teeth. Sheaves are of extra large size for long cable life. The design is fully convertible.

▼

New Heavy Duty Tractor Shovel

The Frank G. Hough Co. of Chicago, manufacturers of tractor shovels, road sweepers, etc., are announcing their new heavy duty hydraulic tractor shovel built especially for the special Allis-Chalmers Model "WM" tractor.

In cooperation with the Allis-Chalmers' engineers, the tractor and the shovel have been designed as one complete unit, the tractor having been especially designed for the requirements of

The Hough Tractor Shovel

the shovel. The complete assembled unit is shipped, ready for operation, from the Allis-Chalmers plant at Springfield, Ill.

The shovel has a ½-yard bucket and will dig any solid dirt or clay and raise the load sufficiently to dump 7 feet from the ground. Thirty to forty yards an hour can be dug and loaded and up to fifty yards of sand, stone, etc., can be loaded into trucks from stock piles, it is claimed.

LeTOURNEAU Owners Whip Tough Conditions Profitably

Le Tourneau owners on job after job, meeting special conditions—long hauls, rock-like shale, heavy muck, buckshot gumbo, deep sand—have whipped those conditions with Le Tourneau equipment, saved the cost of moving in extra machinery, turned potential losses into real profits.

Typical examples are the profitable experiences of Roy L. Houck, veteran Pacific Coast contractor, and Elmer Vogt, up and coming Ohio dirtmover.

Tandems Make Feasible 8,000-Foot Round Trip

Near Salem, Oregon, on Roy L. Houck's 300,000-yard job of straightening and shortening the Pacific Highway, hauls are long, up to 8,000 feet round trip, and the material a tough, heavy, red clay. Houck put six Le Tourneau 12-Yard Carryalls, a Rooter and an Angledozer on the job.

The Carryalls are being used in tandem behind Caterpillar RD8 tractors. So light is the draft of the Le Tourneau Carryall, thanks to big pneumatic tires and heavy-duty roller bearings, that an RD8 can pull these loaded tandem rigs in high, make round trips of 8,000 feet in from 30 to 35 minutes—average time here was 31.5 minutes.

Yardage Greatly Increased

Tandem efficiency as compared with a single unit increases with the distance because loading and dumping time absorb a smaller proportion of the complete operating cycle. Thus on hauls of 2,500 feet, the yardage per tractor is increased fully 80 per cent and costs reduced as much as 50 per cent.

The cable control provided by Le Tourneau Power Control Units is the only operating method now available that permits tandem operation by big-capacity scrapers.

Among the contractors who have profitably whipped long hauls by using Le Tourneau Carryalls in tandem are such well-known earthmovers as Morrison-Knudsen Company, Lane Construction Company, Utah Construction Company, Lewis Construction Company, Crew Brothers, Roy L. Houck, Blanchard Brothers, Peter Kiewit, Kern and Kibbe, and Macco Construction Company.

Houck's tandem rigs rolling bowls full in high on a long haul at Salem, Oregon.

(Below) Le Tourneau Rooter and RD7 tractor making short work of shale.

Rooter Saves Blasting in Excavating Shale

Ordinarily the shale on Elmer Vogt's highway job in Stark County, Ohio, would have been blasted and then moved by shovel and truck. But Vogt had a Le Tourneau Rooter on the job ripping up other material and he decided to see what it would do in shale. The picture here tells the story. This Rooter behind an RD7 ripped the shale to shreds so that Vogt's one 8-Yard and two 12-Yard Carryalls handled it with ease.

Thus with Le Tourneau equipment, Vogt saved the expense of bringing in heavy machinery to handle a tough portion of his job and at the same time cut out the dangers and time usually lost in blasting.

The experiences of Vogt and Houck are similar to those of many another Le Tourneau owner—tough jobs whipped profitably by Le Tourneau equipment, the equipment that is fast making profitless older methods of earthmoving.

Ask your Caterpillar tractor dealer to show you what Le Tourneau equipment can do for you.

R. G. LeTOURNEAU, INC.

PEORIA, ILLINOIS **STOCKTON, CALIFORNIA**

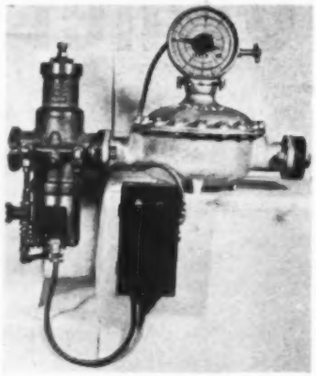
Cable address: "Bobletorno"

Manufacturers of: Angledozers, Buggies, Bulldozers, Carryall Scrapers, Cranes, Drag Scrapers, Power Control Units, Rooters, Semi-Trailers.

LETOURNEAU

New Metering Valve for Measuring Mixing Water

A new metering valve which can be quickly and easily installed on any concrete mixer and is claimed to measure water to a guaranteed accuracy of 1 per cent has been placed on the market by the Spangler Manufacturing Co., 623 East Third St., Los Angeles, Calif.



Spangler Metering Valve

The valve is a compact, self-contained unit, is completely automatic in operation and permits positive and convenient changing of the delivery volume by simply setting the dial to the desired amount.

The accuracy of measurement is secured by mechanically proportioning the hydraulic displacement in the valve and calibrating the meter in the factory laboratory. Changes in the amounts of water delivered per batch of concrete are made by setting a dial which changes the speed of displacement. This in turn changes the quantity of water delivered. The complete cycle is automatic and is started by throwing the operator's lever or, in electrically operated batching plants, by simply pressing a button.

The meter is manufactured in several sizes, permitting the delivery of water in any desired quantities, from the smallest to the largest jobs.

A recent use of the meter, in conjunction with the Spangler timing clock, is for establishing automatic curing intervals in which the meter delivers a predetermined amount of curing water at predetermined intervals. "On" periods may be set in one second increments and "off" periods for any number of minutes desired. The intervals may be predetermined to cover an entire 24-hour cycle and will automatically repeat during the next 24-hour period unless changed. Installations may be made to meet the needs of any concrete construction project.

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New Willett Speed Plows

Willett Manufacturing Corporation of Plymouth, Ind., announce the building of a complete line of new models of hydraulically operated speed snow plows. These include "V" type and one-way blade plows, interchangeable on the same mounting attachments, hydraulically operated for trucks of 1½-ton to 10-ton capacity; reversible-trip blade plows; and hydraulic-operated wings for installation on heavy-duty trucks that may be used independently of or in conjunction with their heavy-duty speed plows; also full hydraulic tractor snow plows. The light plows

A Willett Snow Plow Ready for Use

are available for operation with hand pump in the truck cab, or may be operated by the Willett electric hydraulic pump unit which operates off the truck battery. In the heavier plows and wings, operation is by means of a roller bearing continuous-running oil pump with power take-off operated from the truck transmission. The "V" type and blade plows are built with special curvature of moldboards to facilitate the speedy removal of snow. Literature and complete data are available on request.

WITH THE MANUFACTURERS

Inland Steel Puts Lorenz and Ernst in Charge of St. Louis Sales

Peter M. Lorenz has been appointed by Inland Steel Co., Chicago, as district sales manager of the St. Louis office. Frederick A. Ernst has been designated as assistant manager.

Mr. Lorenz came with the Inland Steel Co. in 1910. During the war he served in the Ordinance Department, being stationed at Buffalo, N. Y., as chief army inspector of ordinance, having charge of inspection at various eastern steel plants. From 1919 to 1921, Mr. Lorenz was in charge of the Detroit office of the Inland Steel Company. Since then he has been associated with the Chicago sales force.

Mr. Ernst first entered the steel industry in 1914 with the Trumbull Steel Co., Warren, Ohio, and later was transferred to their Chicago office, until 1922 when he became affiliated with the Falcon Steel Co. Later he was associated with the Granite City Steel Co., and then the Columbia Steel Co. In 1928 he became associated with the St. Louis office of the Inland Steel Co.

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Lehman of Blaw-Knox Dies

Irvin F. Lehman

Irvin F. Lehman, president and one of the founders of Blaw-Knox Company, died Wednesday evening, August 5, in Hartford, Conn., after a prolonged illness of several months' duration. Mr. Lehman had not been active in the affairs of the company or its connections for nearly a year. Mr. Lehman was born in Pittsburgh, Pa., March 10, 1877, a son of Moses Lehman and Fanny Frank Lehman. He was educated in the Pittsburgh public and high schools and in the Park Institute of Pittsburgh. After his graduation he became interested in the development of water-cooled devices for high temperature melting furnaces, a new departure in this type of equipment. Shortly after this he organized the Knox Pressed and Welded Steel Company, which was successful from its inception, being merged in 1917 with the Blaw Steel Construction Company.

Mr. Lehman held many other business posts, taking an active part in the operation and development of Blaw-Knox Construction Company, Hoboken Land Company, National Alloy Steel Company, Union Steel Casting Company, Lewis Foundry and Machine Company, Pittsburgh Rolls Corporation, Blaw-Knox Limited of London, England, Compagnie Francaise Blaw-Knox of Paris, France, and Blaw-Knox International Corporation.

Mr. Lehman was well known in the industrial and civic life of the city and was intensively interested in philanthropic work. He was one of the organizers of the Federation of Jewish Philanthropies, being president of that organization for many years. He was also a director of the Community Fund of the city of Pittsburgh, the Pennsylvania Public Charities Association, the Irene Kaufmann Settlement, and many other welfare, philanthropic and business associations. His time, energies and abilities were given as freely to these as to his personal and business interests. He was a member of the Rodef Shalom Congregation of the city of Pittsburgh, Allegheny Lodge No. 223, A. F. & A. M., and vice-president of Fox Chapel District Association.

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FWD Has New Service Manager

E. E. Giessel has been appointed manager of the parts, shipping and service departments of the Four Wheel Drive Auto Company, Clintonville, Wisc., it is announced. With the company since 1930, Giessel filled a position in the factory, became parts manager, and recently served as special assistant to W. A. Olen, president. As service manager he succeeds Charles H. Redman, who resigned, effective September 1, to study law at Marquette University, Milwaukee.

Broderick & Bascom Open Chicago Office and Warehouse

Broderick & Bascom Rope Company announce the opening of a branch office and warehouse at 1500 South Western Avenue, Chicago, Ill., where they will carry large stocks of B. & B. standard construction as well as Flex-Set Preformed construction wire rope.

Their present distributors in Chicago and in the North Central states will continue to represent them, and with the large stock available at Chicago it will be possible to make quick shipment and render more prompt service than in the past.

E. M. Stephanus, who has been associated with the company for a great many years, will be in charge of the Chicago office.

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Ross Snow Plow Representatives Meet at the Burch Corporation Plant

Ross Snow Plow representatives from every state in the Snow Belt met recently to inspect the 1937 models.

Forty-six of the organization of two hundred are shown in the accompanying illustration.

Lester T. Ross, who was the originator of the moldboard type

plow, is the central figure of the three seated on one of the smaller plows in the foreground. Mr. J. L. Morrow, president and general manager of The Burch Corporation, builders of Ross Plows, is on the extreme left.

The complete 1937 line includes a wide range in sizes of both one-way plows and V-type plows, in addition to sidewalk plows. Many new and exclusive features are in evidence.

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NEW LITERATURE

Shovel-Dragline-Crane—An attractive illustrated folder No. 1569 has been completed by Link-Belt Company, 300 W. Pershing Road, Chicago, on its recently announced Speed-O-Matic Shovel-Dragline-Crane.

This new folder sets forth the advantages of the new power control with its short, fast, easy-throw levers, as compared with operating the older type of long, hard-throw levers. A chart shows how the element of operator fatigue substantially reduces the handling efficiency of the conventional lever controlled machine as the day progresses, even though the machine itself is physically able to do as much work then as at the beginning of the shift.

A copy of the folder will be sent to any reader upon request addressed to the company.

Dragline Equipment and Operation—The current issue of Sauerman News, published by Sauerman Bros., Inc., 438 S. Clinton St., Chicago, carries a number of very interesting illustrated articles on dragline work in such varied service as surface mining on a mountain side, sewage plant operation, coal handling, earth dam construction, and aggregate storage and handling.

Stabilization—The 1936 edition of Technical and and Engineering Service Bulletin No. 1, "Road Surface Stabilization—Materials and Methods for Construction and Maintenance of Low Cost Stabilized Roads," was issued in August by Solvay Sales Corporation, 40 Rector St., New York.

This new fifth edition is 50 per cent larger than the fourth edition, which was issued last year, and now contains 76 pages and 82 illustrations, along with charts, diagrams and tables covering practically every phase of stabilization. Among the new or enlarged sections are "Plant Mixing of Materials," "Construction of Wearing Courses from Ready Mixed Materials," "Fine Aggregate Mixtures (Sand-Clay)," "Special Machinery and Equipment," and "Maintenance."

The bulletin is available without charge to engineers and highway officials.

Steel—"Steel Physical Properties Atlas," by C. N. Dawe, is a clothbound volume of 88 pages, 8½x11 inches, giving in summary form with tables and diagrams the principal physical properties of all the common varieties of steel. It is published by the American Society for Metals, 1016 Euclid Avenue, Cleveland, Ohio.

Diesel Fuel Tractor—"Model 'KO' Standard and Wide Tread Tractors" is the title of an attractive new catalog just issued by Allis-Chalmers Mfg. Company, Milwaukee. The catalog contains complete information on the new Model "KO" Diesel fuel tractor recently announced.

Features and improvements on the "KO" are described and illustrated in an interesting manner. The principles of the controlled-ignition engine, which engine has won widespread attention, are explained in clear, concise form, and several pages are devoted to the simple, new injection system developed by Allis-Chalmers.

Fuel and lubricating systems are illustrated with cross-section views in color and important features of construction of the "KO" are described.

Action pictures of the "KO" working on a variety of jobs are shown in the 32-page catalog. Copies of the catalog can be secured from Allis-Chalmers dealers or branches located in all principal cities or by writing to the company at Milwaukee.

Stress Distribtion in Steel Rigid Frames—The second progress report on the stress of steel rigid frames by the National Bureau of Standards, U. S. Department of Commerce, in cooperation with American Institute of Steel Construction, 200 Madison Ave., New York City, was issued in August. These reports cover tests and analyses on full-size rigid frames of the type used in many highway bridges. Progress Report No. 2 gives the results of the tensile tests of the coupons for the rigid frame, No. 1, fabricated by the Bethlehem Steel Company, and also the stress distribution near the knee of this frame after the corner gusset plates had been removed.

Emulsified Carbon Black—A four-page folder entitled "Blac-King," issued by Colloidal Pigment Co., Inc., Clinton, N. Y., sets forth briefly the characteristics of emulsified carbon and its uses in toning cement mixture to gray or black.

Petroleum Products in Daily Life—A newly issued brochure entitled "Black Gold" published by N. W. Ayer & Son, Inc., Washington Square, Philadelphia, gives a broad, general statement of the uses of petroleum and the status of the petroleum industry in simple and attractive language.

Bituminous Distributors—Bulletin A-1936 of the Kinney Manufacturing Company, 3537 Washington St., Jamaica Plain, Boston, Mass., contains a clear and systematic account of distributors and other bituminous handling equipment made by that company. There are illustrations of entire units and also details of mechanism. Specifications together with tables of weights and dimensions are included. The units are classified as Model A—all-purpose heavy unit, Model B—special-purpose unit, Model C—general service unit.